

sPHENIX INTT - beam test noise level

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Content

- Noise hit extraction method
- Number of track distribution & 3 tracks event
- Noise hit distribution
- Comparison, # of track distribution, track correlation
 - With the run61 (with lead plate in front of the INTT box)
- Track size distribution
 - With the run61 (vertical rotation 13.7 degree)

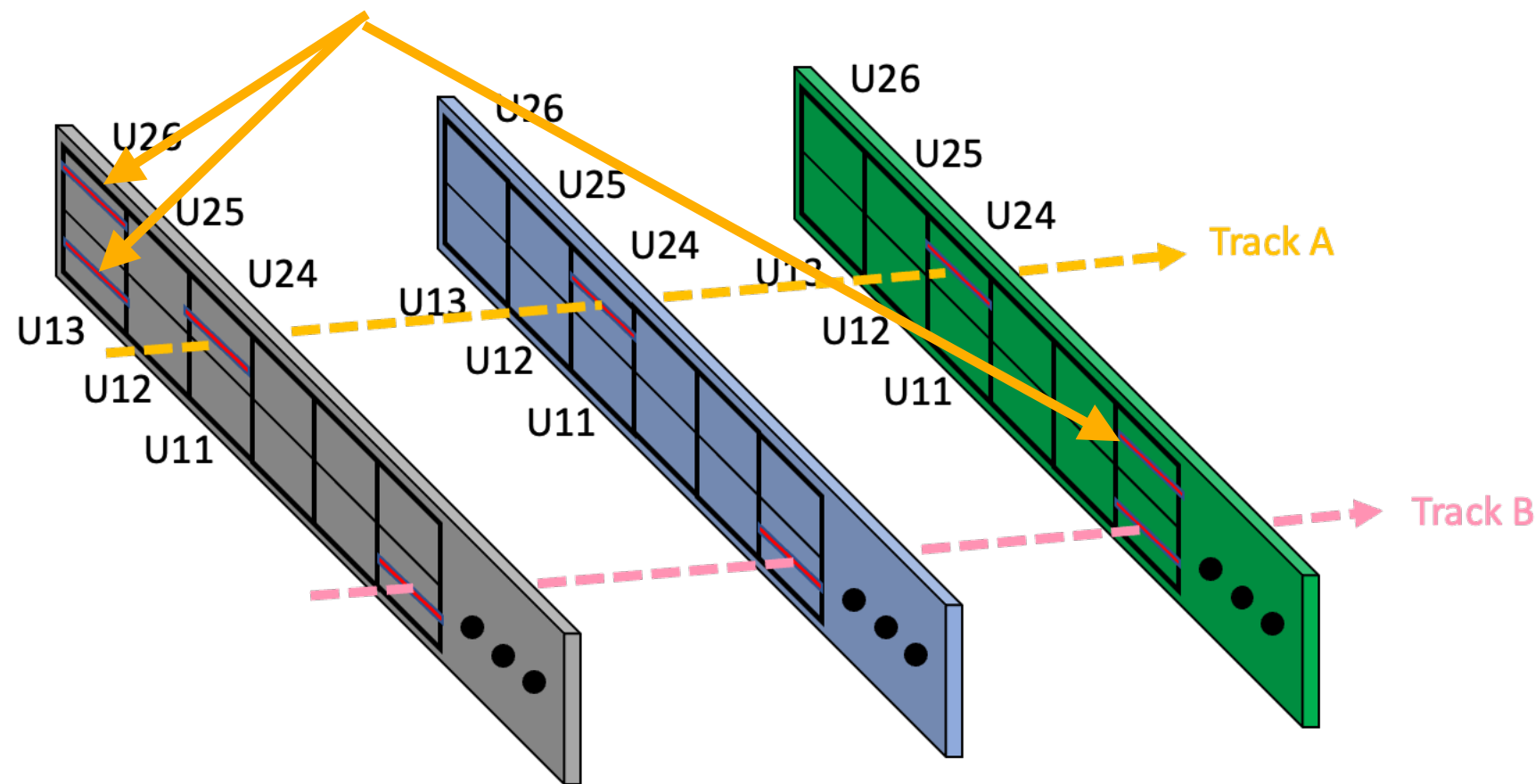
Noise level estimation - Method 3, remove multi-tracks

Residual tolerance : same (same as chip 8)

Criteria :

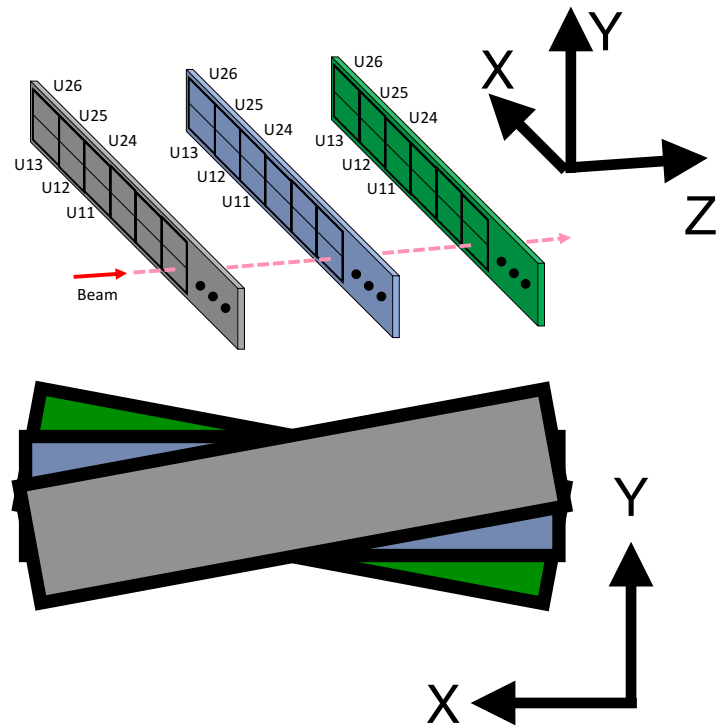
1. Remove all good tracks in this event (1st, 2nd, 3rd, ...)
 - Good track definition : residual < 0.1374 mm (Run 52)
2. For the remaining clusters, the size of the cluster == 1
3. Adc value (energy deposit) == 22.5 (adc0)

Considered as noise hits (assume cluster size is 1)



In the example :
9 clusters → 2 good tracks
3 noise hits

Layer-1 alignment, universal correction



The function of the layer-1 alignment correction

Type A sensor : from Run 52

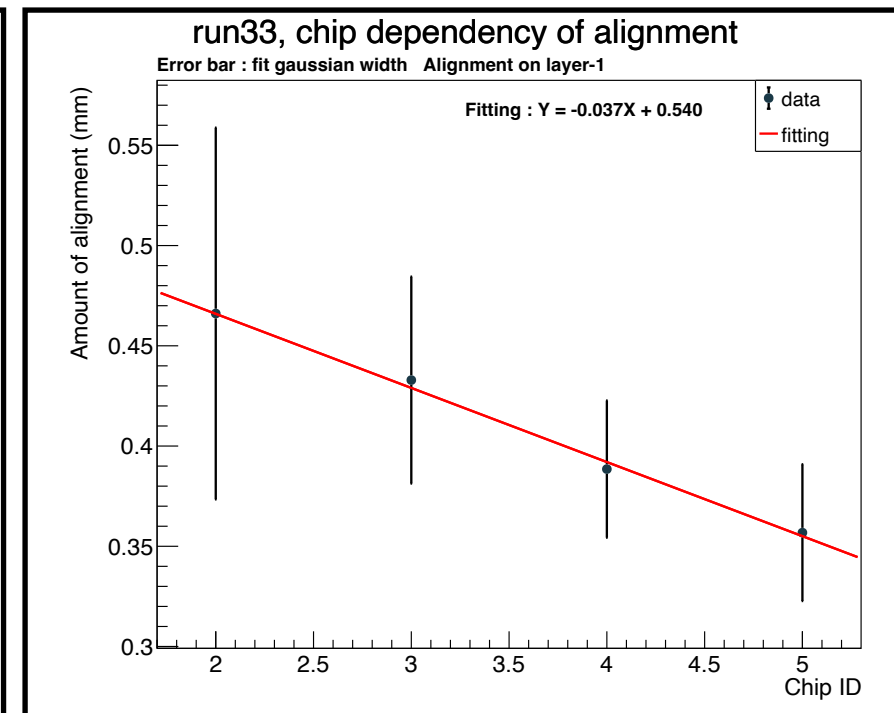
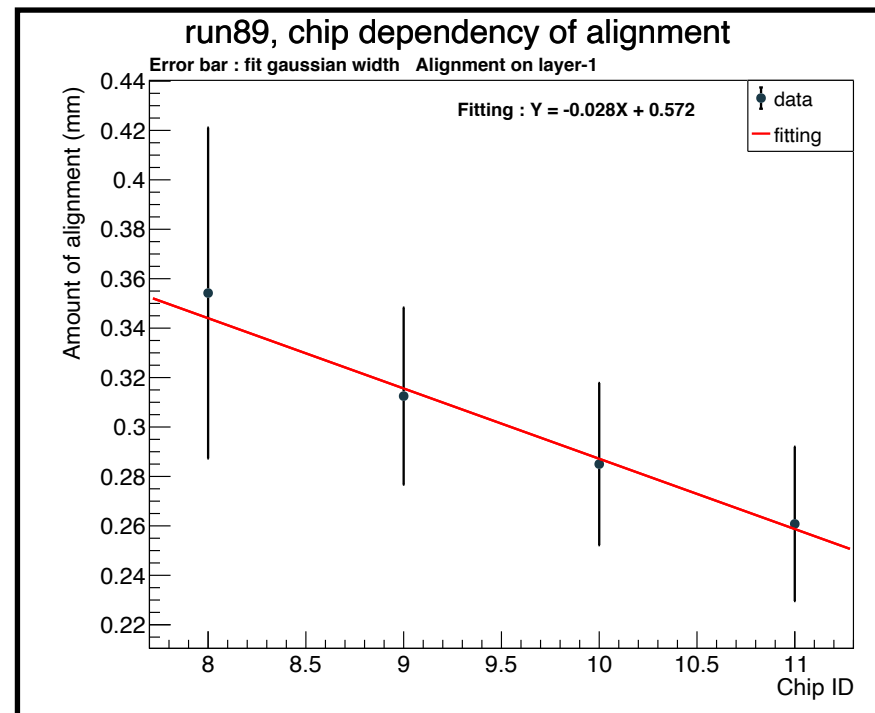
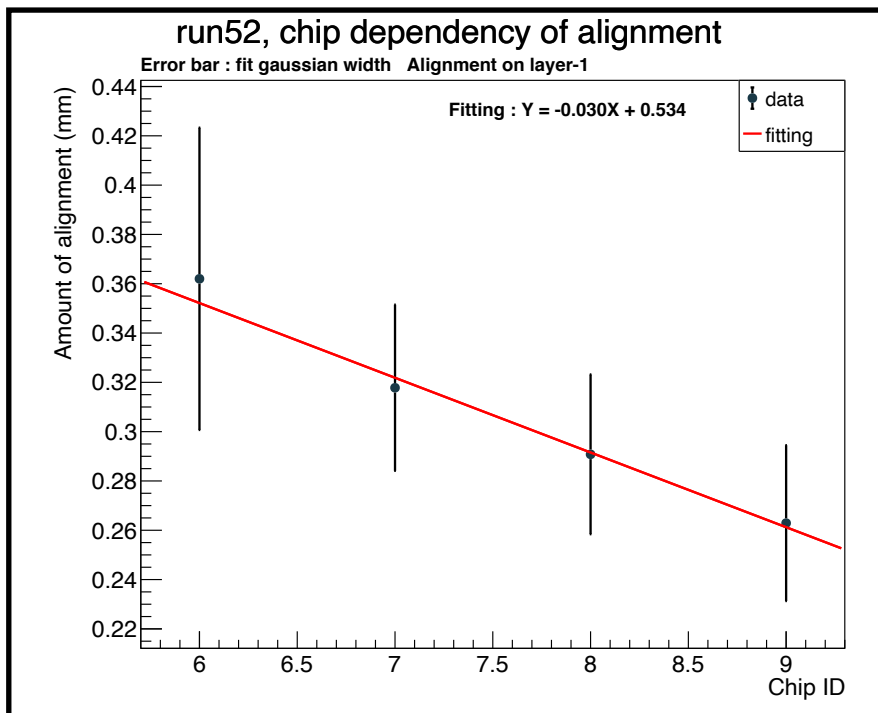
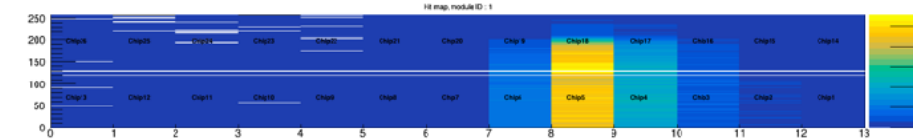
Type B sensor : from Run 33 (Due to low statistic at sensor B of run 52)

Run 52

Run 89

Run 33

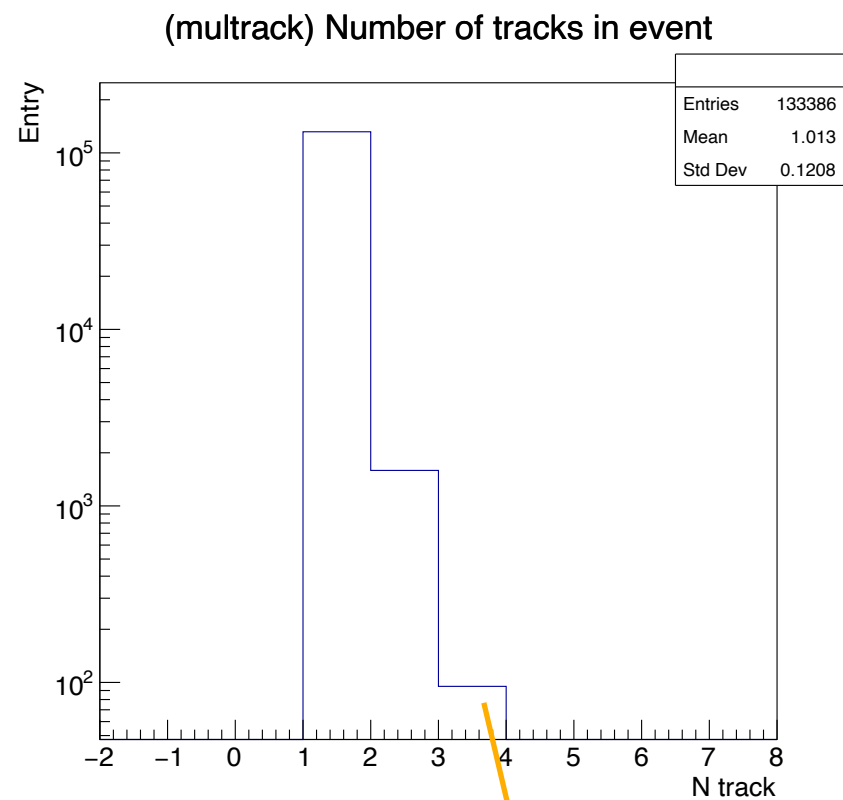
Beam spot is in sensor B



Sensor A

Sensor B

3 tracks, run52, eID 64018 check



File : run52_no_clone.root
One of the 3-good-tracks event

Layer 0 : 3 clusters
Layer 1 : 3 clusters
Layer 2 : 3 clusters

Event ID			Layer	Chip	Channel	ADC	BCO full	
64 *	80 *	-1 *	1 *	8 *	21 *	2 *	124 *	48508 *
64 *	81 *	-1 *	1 *	8 *	32 *	2 *	124 *	48508 *
64 *	82 *	-1 *	1 *	8 *	122 *	3 *	124 *	48508 *
64 *	83 *	-1 *	6 *	8 *	14 *	2 *	124 *	48508 *
64 *	84 *	-1 *	6 *	8 *	25 *	0 *	124 *	48508 *
64 *	85 *	-1 *	5 *	8 *	2 *	2 *	124 *	48508 *
64 *	86 *	-1 *	5 *	8 *	14 *	4 *	124 *	48508 *
64 *	87 *	-1 *	5 *	8 *	26 *	2 *	124 *	48508 *
64 *	88 *	-1 *	6 *	8 *	26 *	3 *	124 *	48508 *
64 *	89 *	-1 *	6 *	8 *	27 *	4 *	124 *	48508 *
64 *	90 *	-1 *	6 *	8 *	79 *	2 *	124 *	48508 *
64 *	91 *	-1 *	6 *	8 *	80 *	0 *	124 *	48508 *

This event has 3 good tracks (based on the algorithm)

3 tracks, run52, eID 64018 check

run52_no_clone.root

Event ID			Layer	Chip	Channel	ADC	BCO full	
64 *	80 *	-1 *	1 *	8 *	21 *	2 *	124 *	48508 *
64 *	81 *	-1 *	1 *	8 *	32 *	2 *	124 *	48508 *
64 *	82 *	-1 *	1 *	8 *	122 *	3 *	124 *	48508 *
64 *	83 *	-1 *	6 *	8 *	14 *	2 *	124 *	48508 *
64 *	84 *	-1 *	6 *	8 *	25 *	0 *	124 *	48508 *
64 *	85 *	-1 *	5 *	8 *	2 *	2 *	124 *	48508 *
64 *	86 *	-1 *	5 *	8 *	14 *	4 *	124 *	48508 *
64 *	87 *	-1 *	5 *	8 *	26 *	2 *	124 *	48508 *
64 *	88 *	-1 *	6 *	8 *	26 *	3 *	124 *	48508 *
64 *	89 *	-1 *	6 *	8 *	27 *	4 *	124 *	48508 *
64 *	90 *	-1 *	6 *	8 *	79 *	2 *	124 *	48508 *
64 *	91 *	-1 *	6 *	8 *	80 *	0 *	124 *	48508 *

One cluster

run52_no_clone_filter_all_int_1000.root (filter the double counting)

```
root [3] tree_both->Scan("camac_adc:camac_tdc:INTT_event:module:chip_id:chan_id:adc:nele:DSE:eID","eID == 64018")
```

* Row *	* Instance *	* camac_adc *	* camac_tdc *	* INTT_event *	* module *	* chip_id *	* chan_id *	* adc *	* nele *	* DSE *	* eID *
* 2394 *	0 *	4 *	2153 *	1 *	1 *	8 *	21 *	2 *	12 *	0 *	64018 *
* 2394 *	1 *	275 *	262 *	1 *	1 *	8 *	32 *	2 *	12 *	0 *	64018 *
* 2394 *	2 *	320 *	397 *	1 *	1 *	8 *	122 *	3 *	12 *	0 *	64018 *
* 2394 *	3 *	136 *	886 *	1 *	6 *	8 *	14 *	2 *	12 *	0 *	64018 *
* 2394 *	4 *	*	2153 *	1 *	6 *	8 *	25 *	0 *	12 *	0 *	64018 *
* 2394 *	5 *	*	2153 *	1 *	6 *	8 *	26 *	3 *	12 *	0 *	64018 *
* 2394 *	6 *	*	*	1 *	6 *	8 *	27 *	4 *	12 *	0 *	64018 *
* 2394 *	7 *	*	*	1 *	6 *	8 *	79 *	2 *	12 *	0 *	64018 *
* 2394 *	8 *	*	*	1 *	6 *	8 *	80 *	0 *	12 *	0 *	64018 *
* 2394 *	9 *	*	*	1 *	5 *	8 *	2 *	2 *	12 *	0 *	64018 *
* 2394 *	10 *	*	*	1 *	5 *	8 *	14 *	4 *	12 *	0 *	64018 *
* 2394 *	11 *	*	*	1 *	5 *	8 *	26 *	2 *	12 *	0 *	64018 *

3 tracks, run52, eID 64018 check

```
root [3] tree_both->Scan("camac_adc:camac_tdc:INTT_event:module:chip_id:chan_id:adc:nele:DSE:eID","eID == 64018")
```

Row	Instance	camac_adc	camac_tdc	INTT_event	module	chip_id	chan_id	adc	nele	DSE	eID
2394	0	4	2153	1	1	8	21	2	12	0	64018
2394	1	275	262	1	1	8	32	2	12	0	64018
2394	2	320	397	1	1	8	122	3	12	0	64018
2394	3	136	886	1	6	8	14	2	12	0	64018
2394	4		2153	1	6	8	25	0	12	0	64018
2394	5		2153	1	6	8	26	3	12	0	64018
2394	6			1	6	8	27	4	12	0	64018
2394	7			1	6	8	79	2	12	0	64018
2394	8			1	6	8	80	0	12	0	64018
2394	9			1	5	8	2	2	12	0	64018
2394	10			1	5	8	14	4	12	0	64018
2394	11			1	5	8	26	2	12	0	64018

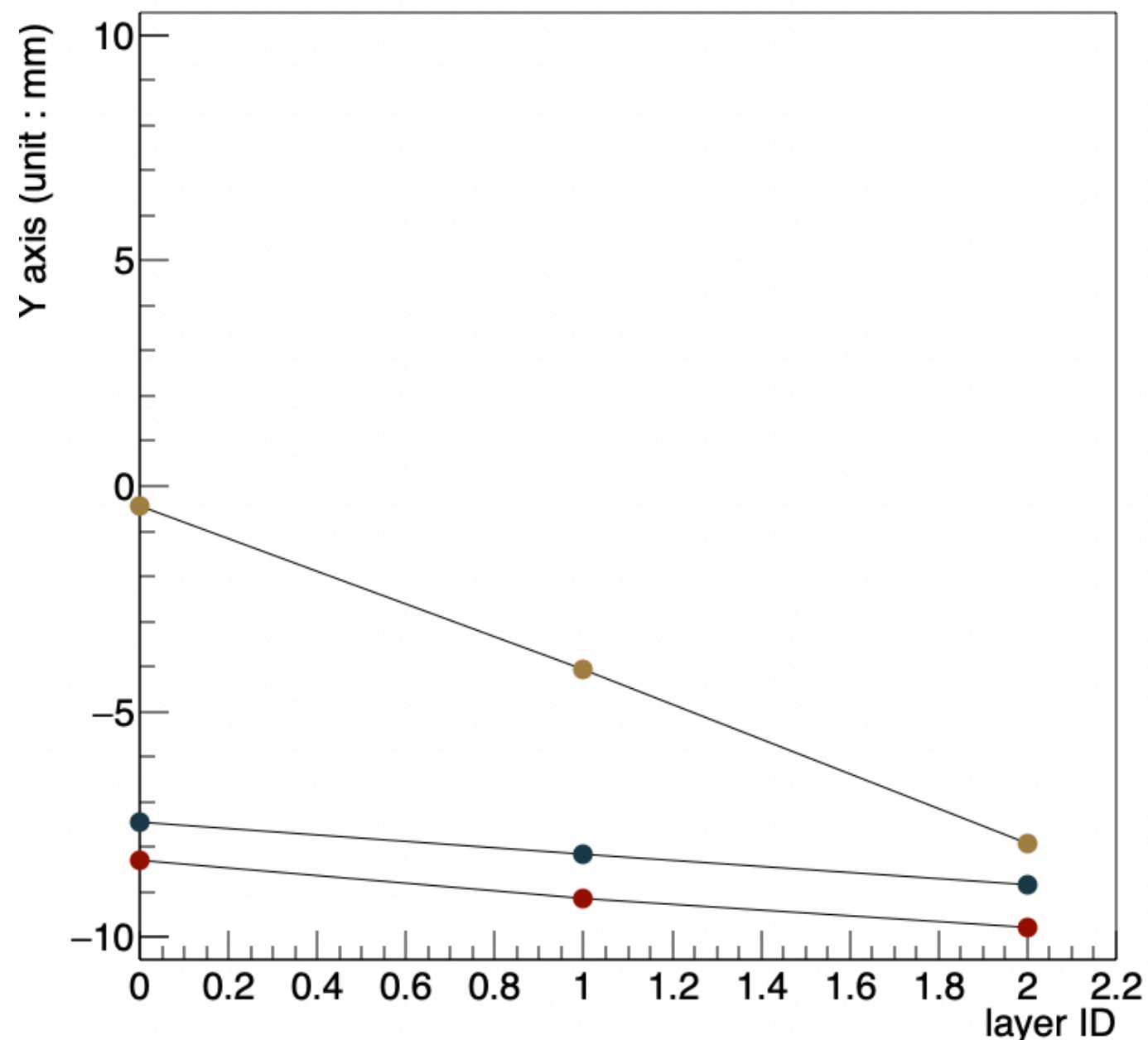
layer	channel hit	position (energy weight)	layer-1, U8 alignment correction	final position
0 (module = 1)	21	-8.3070	0	-8.307
0	32	-7.4490	0	-7.449
0	122	-0.4290	0	-0.429
1 (module = 6)	14	-8.8530	-0.294	-9.147
1	25, 26, 27	-7.8836	-0.294	-8.1776
1	79, 80	-3.7650	-0.294	-4.059
2 (module = 5)	2	-9.7890	0	-9.789
2	14	-8.8530	0	-8.853
2	26	-7.9170	0	-7.917

```
find the 1th track !! chip ID : 8 eID : 64018 position : -7.449 -8.17757 -8.853
find the 2th track !! chip ID : 8 eID : 64018 position : -8.307 -9.147 -9.789
find the 3th track !! chip ID : 8 eID : 64018 position : -0.429 -4.059 -7.917
```

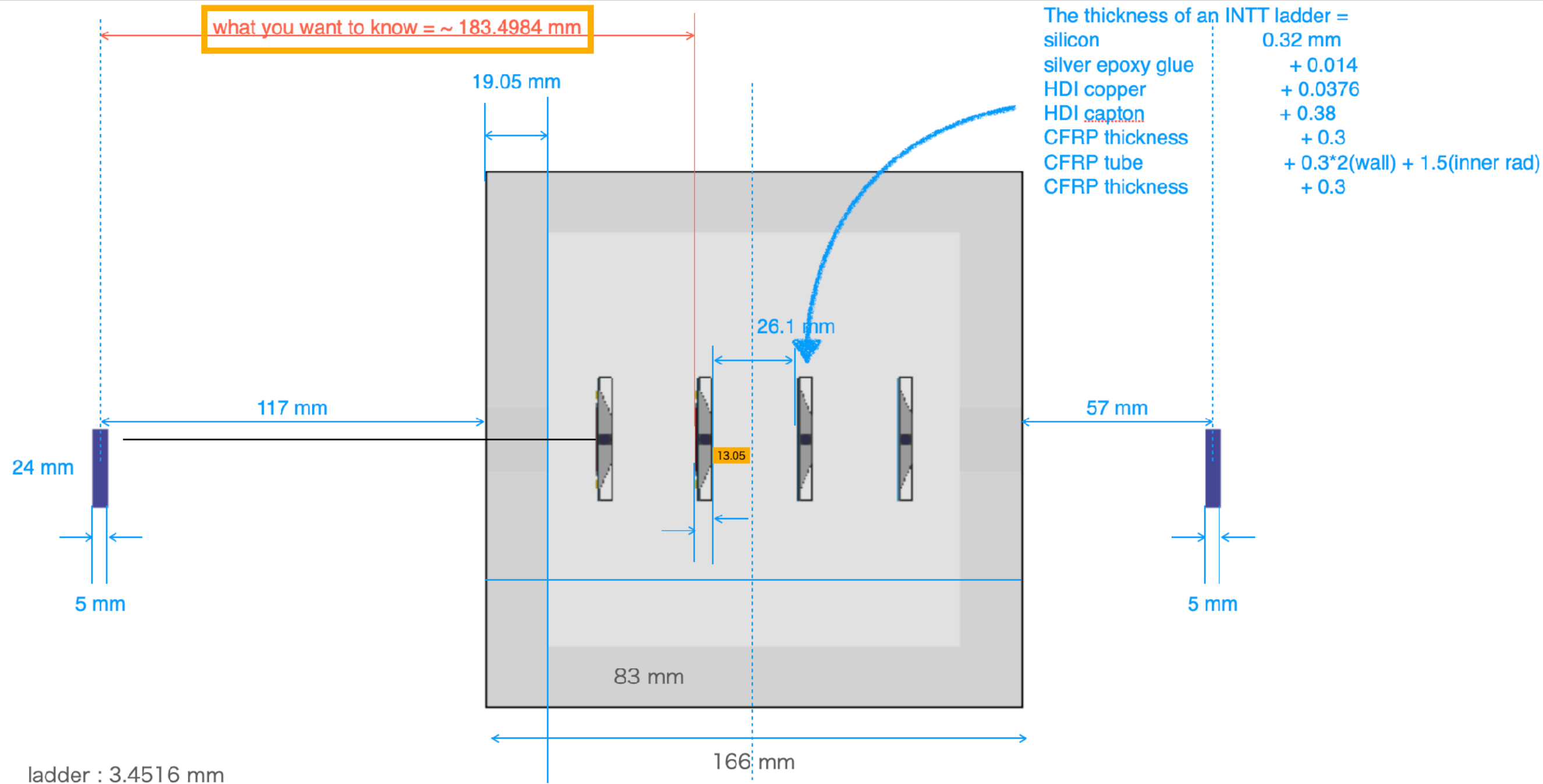
3 tracks, run52, eID 64018 check

```
find the 1th track !! chip ID : 8 eID : 64018 position : -7.449 -8.17757 -8.853
find the 2th track !! chip ID : 8 eID : 64018 position : -8.307 -9.147 -9.789
find the 3th track !! chip ID : 8 eID : 64018 position : -0.429 -4.059 -7.917
```

Run52, eID : 64018, 3 good tracks



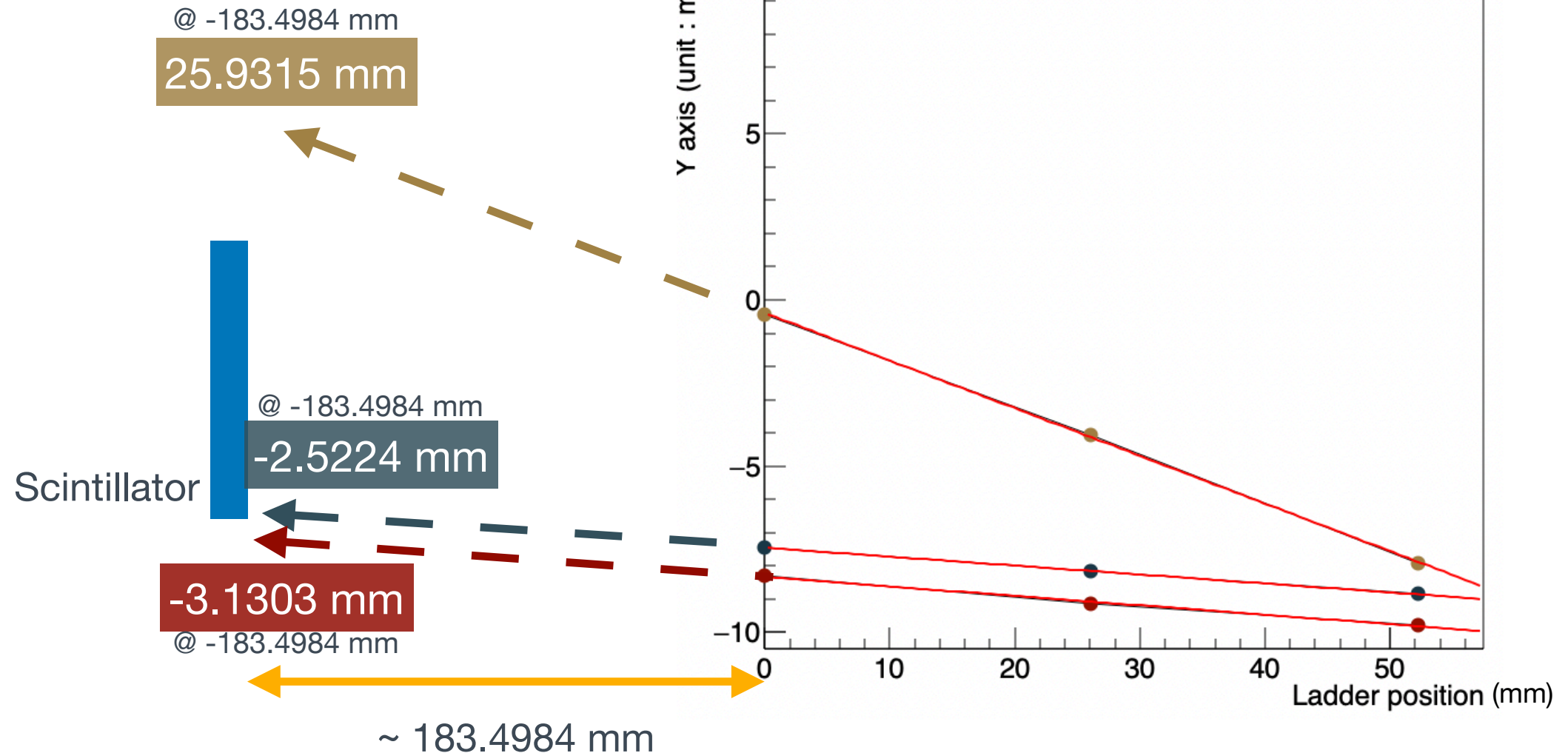
INTT Geometry (to be confirmed)



3 tracks, run52, eID 64018 check

Do the extrapolation to the closest scintillator

Seems to be not from the beam



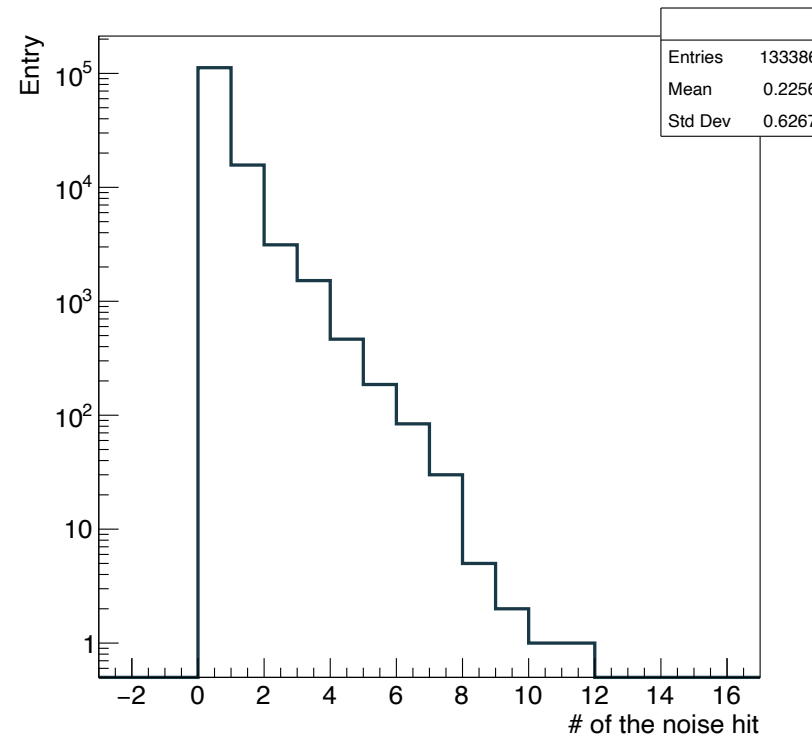
Run 52 - method 3, noise level

Criteria :

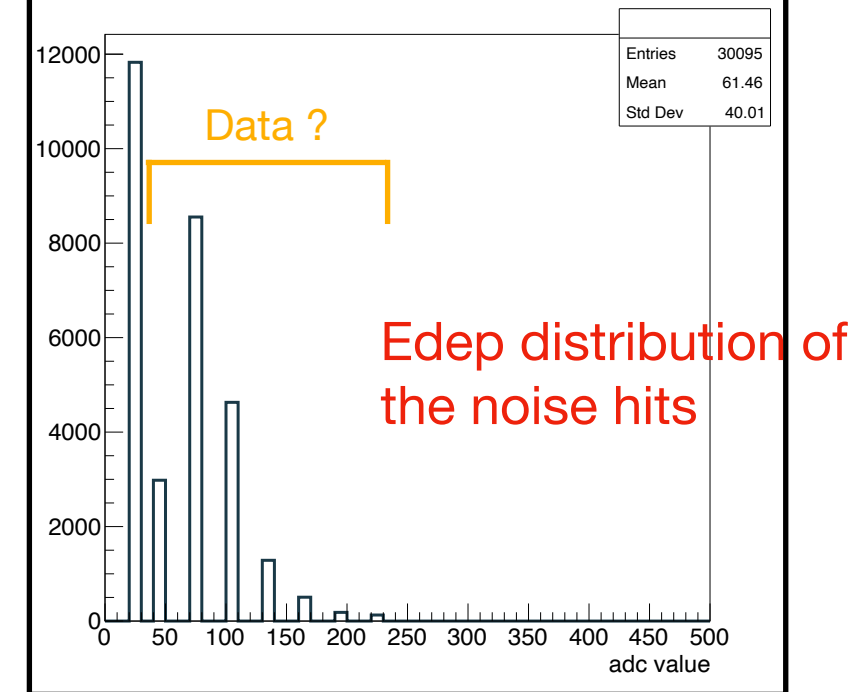
1. Have at least one good track
2. cluster size == 1

15.83% of the events have at least one additional hit (cluster size == 1) besides **at least one** good track.

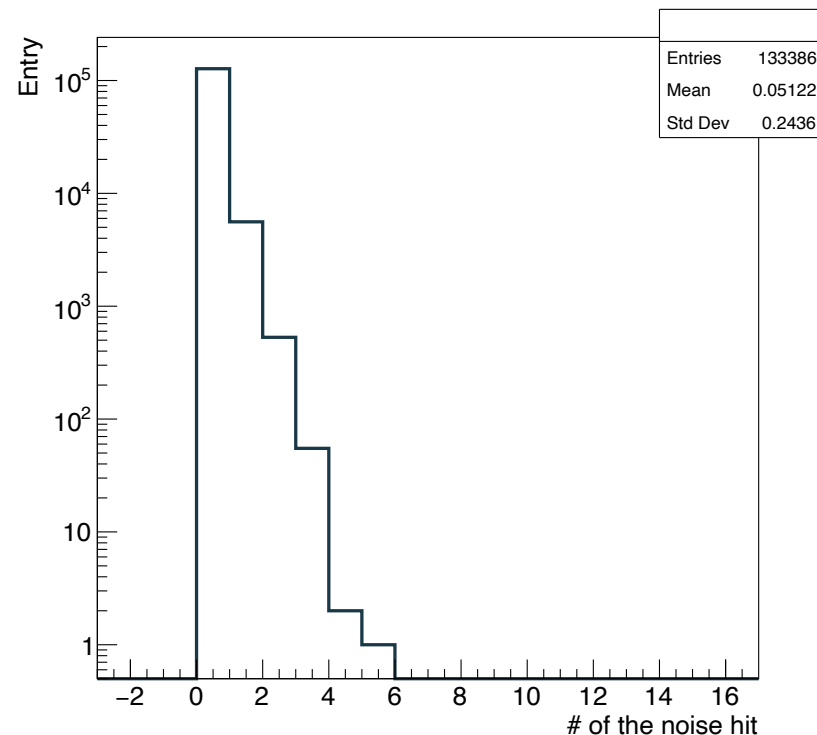
(mul-track removal) Run52, noise level, layer combined



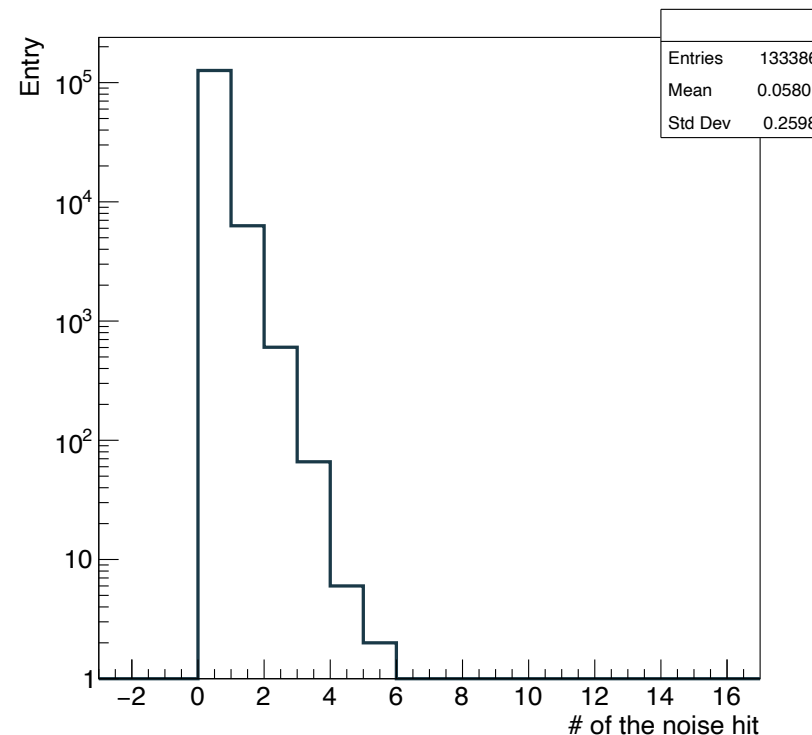
Noise adc distribution (δ -ray electron + noise hit)



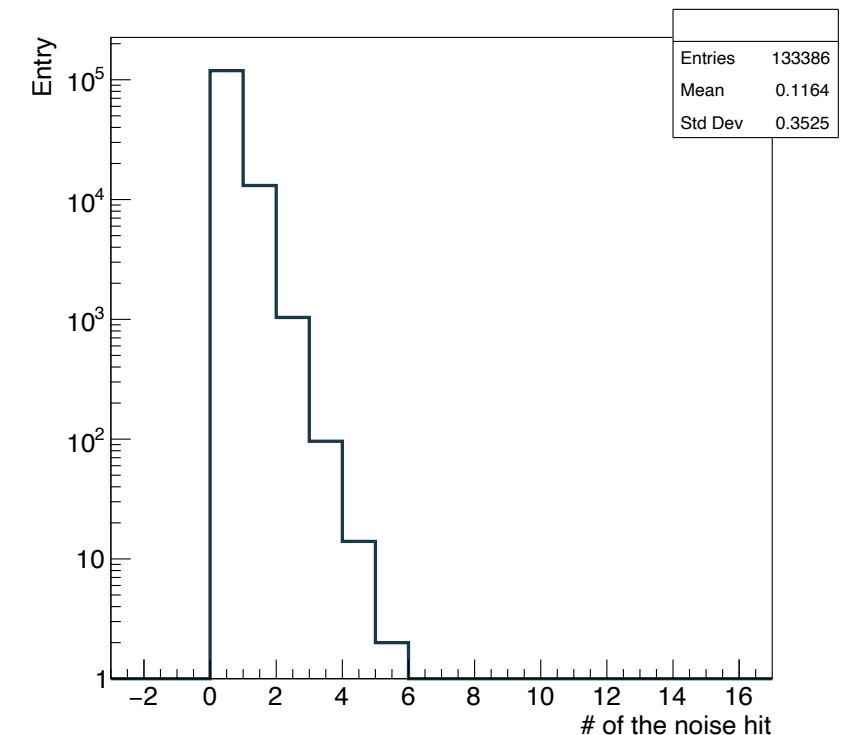
(mul-track removal) Run52, noise level, layer 0



(mul-track removal) Run52, noise level, layer 1



(mul-track removal) Run52, noise level, layer 2

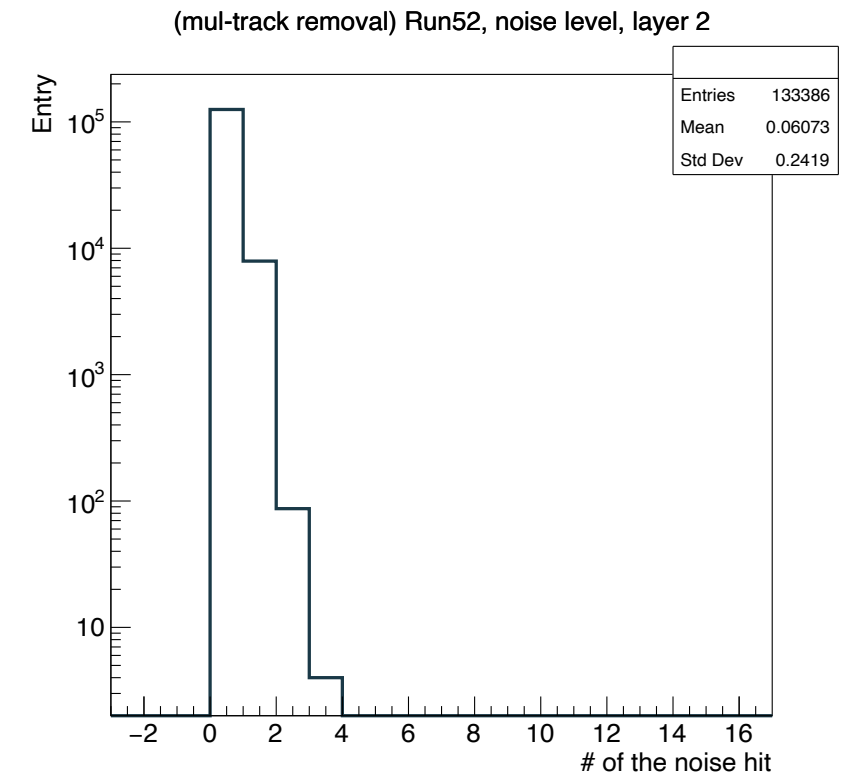
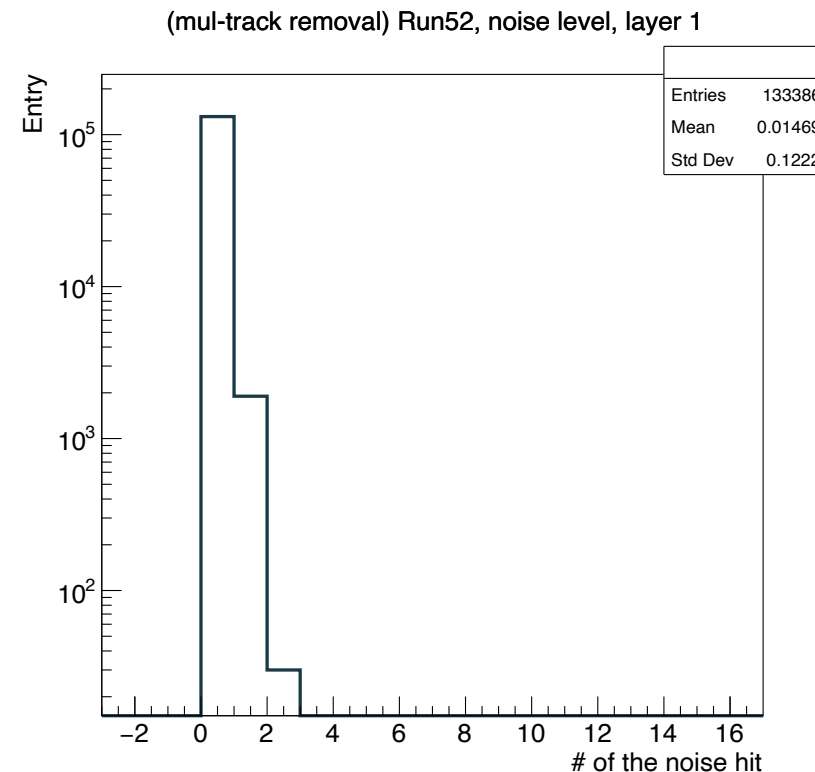
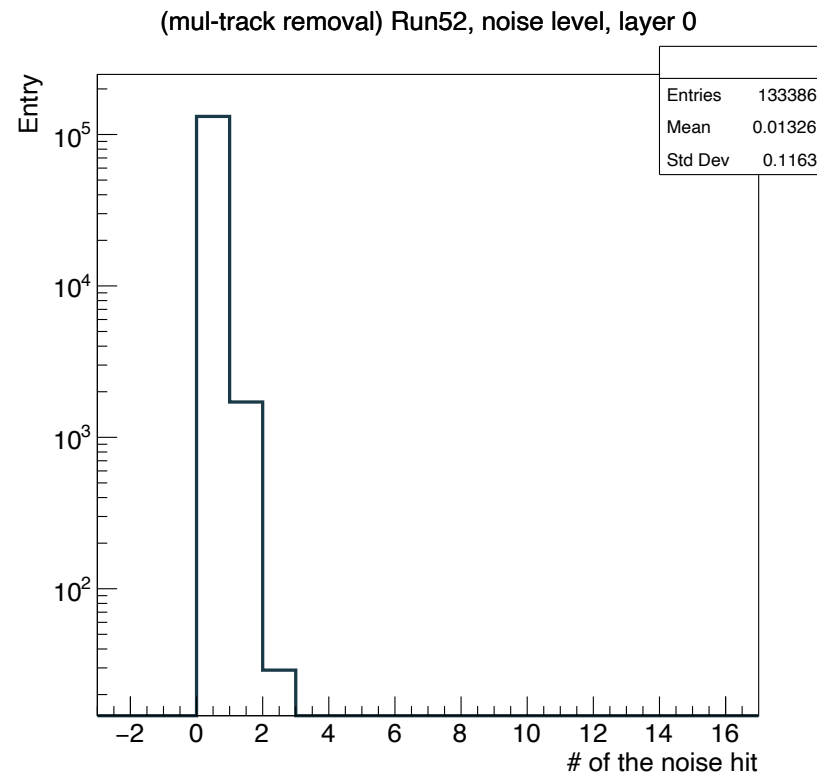
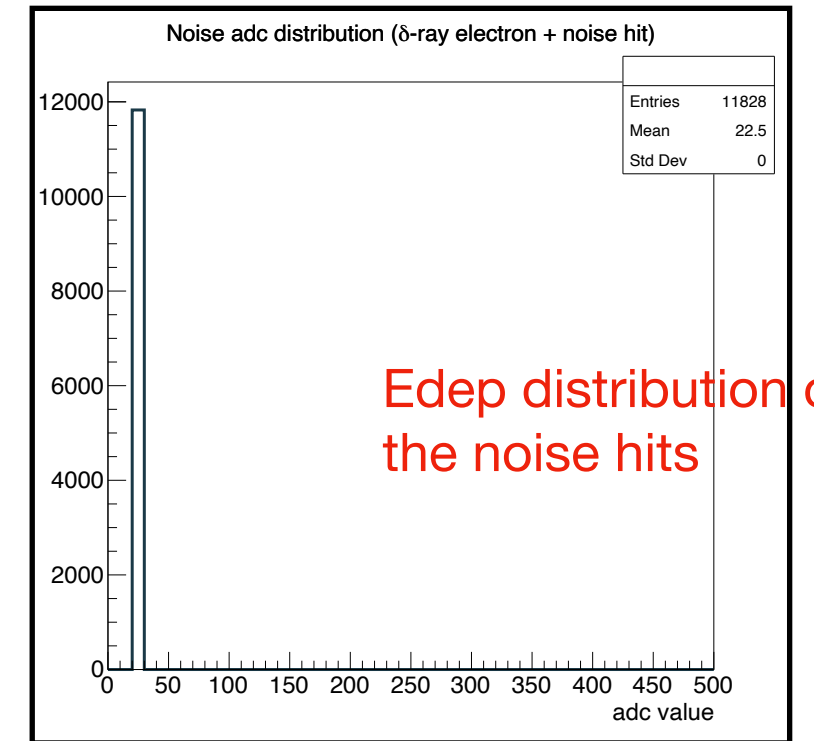
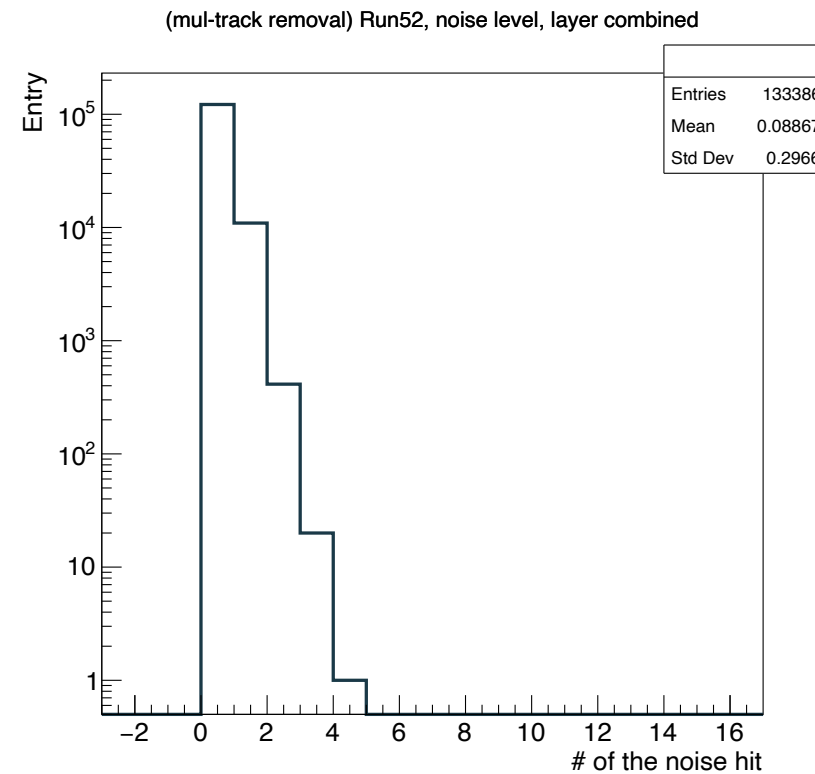


Run 52 - method 3, noise level

Criteria :

1. Have at least one good track
2. cluster size == 1
3. ADC value == 22.5

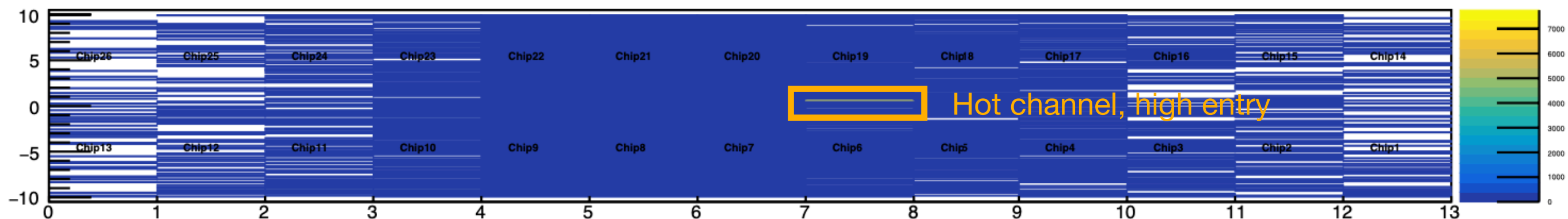
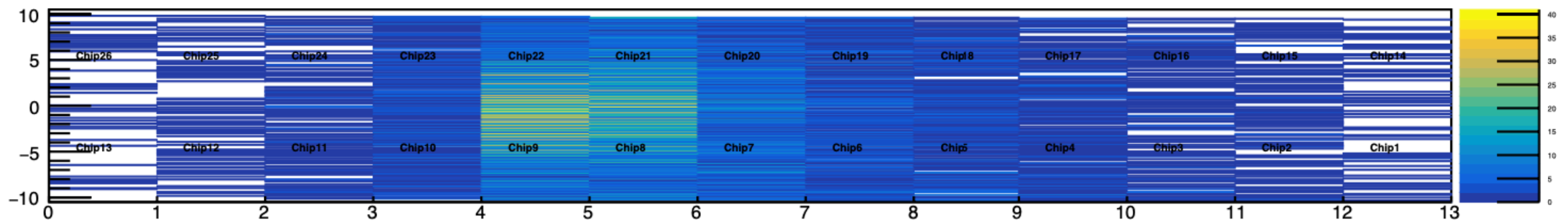
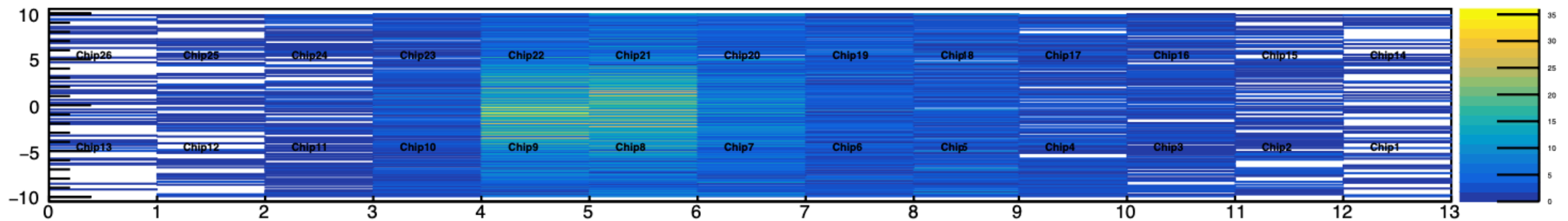
8.52% of the events have at least one additional hit (cluster size == 1) besides at least one good track.



Run 52 - method 3, noise hit map

Criteria :

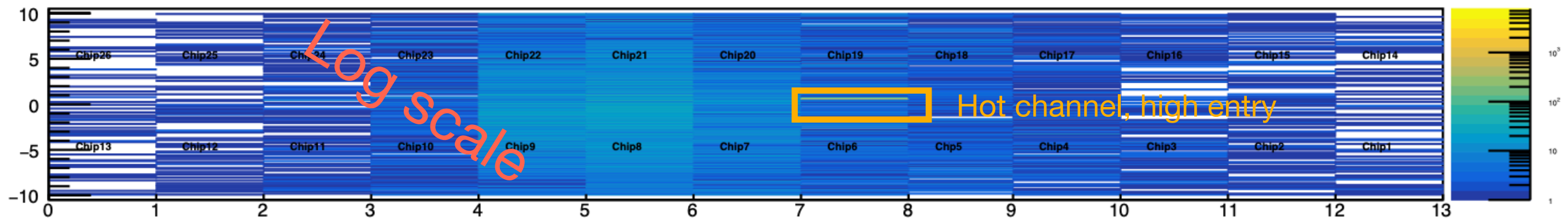
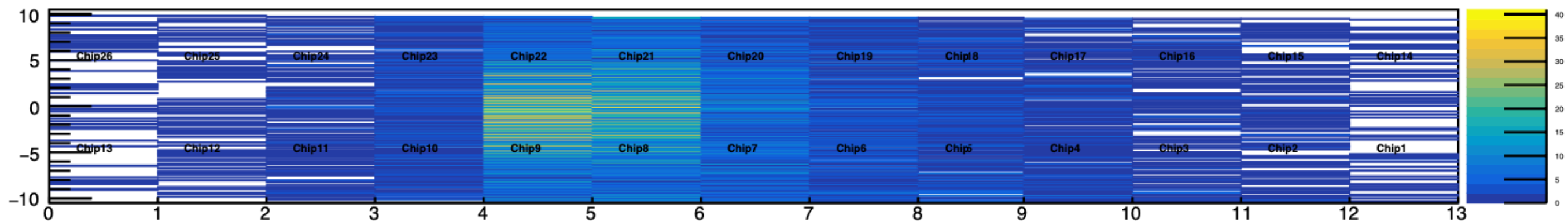
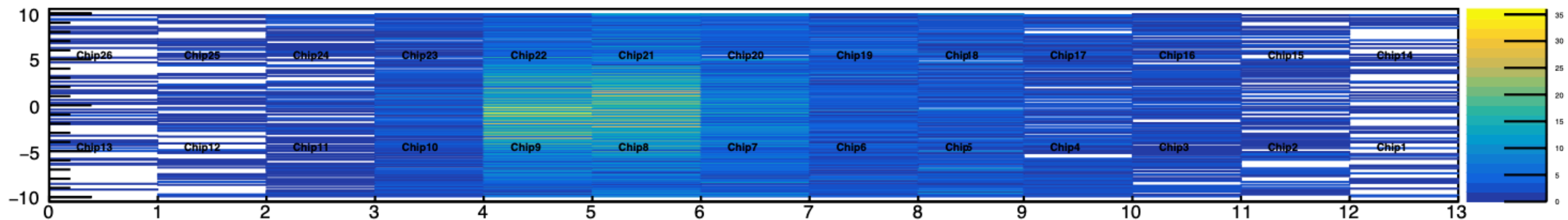
1. Have at least one good track
2. cluster size == 1



Run 52 - method 3, noise hit map

Criteria :

1. Have at least one good track
2. cluster size == 1

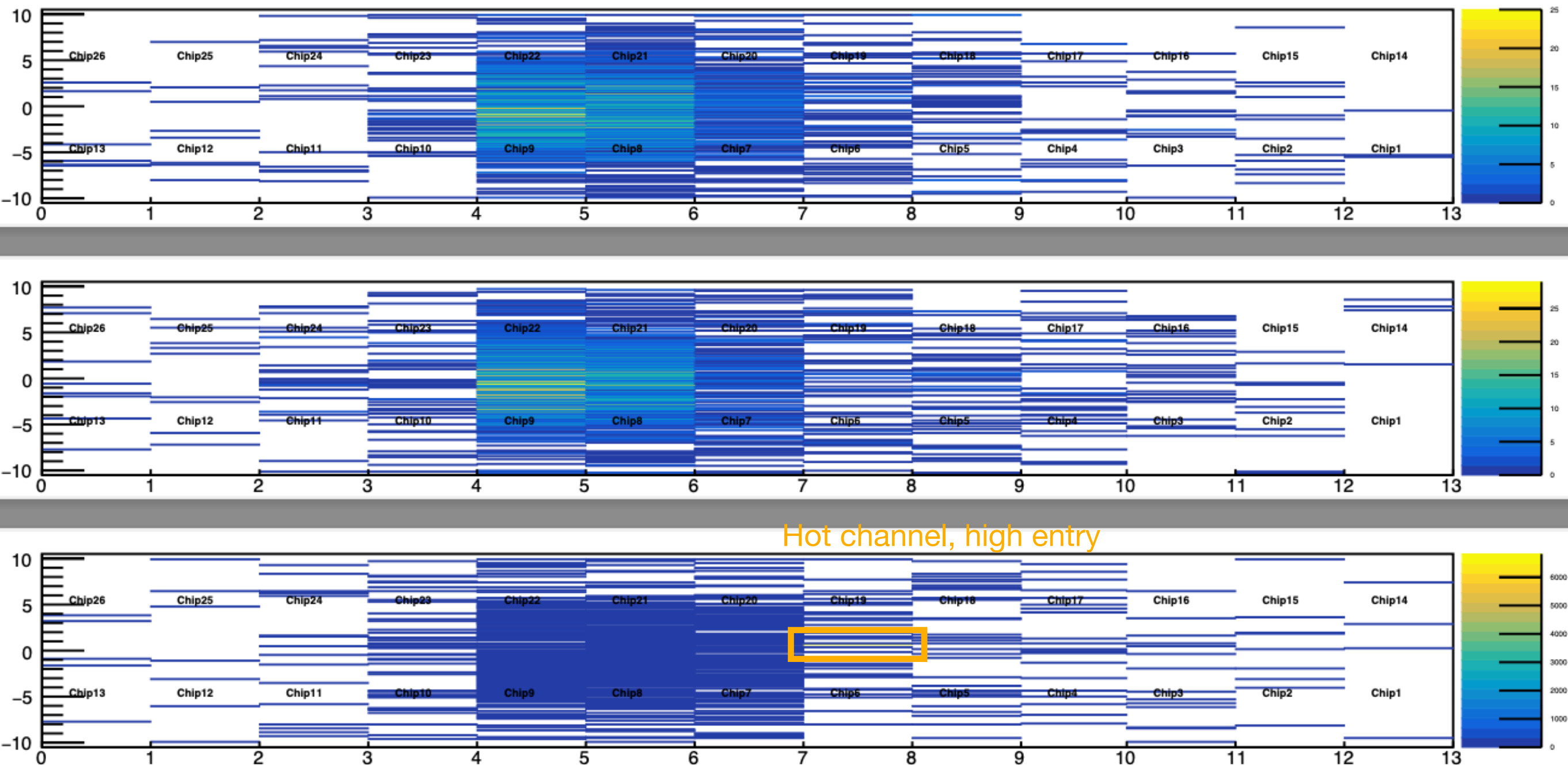


Run 52 - method 3, noise hit map

Criteria :

1. Have at least one good track
2. cluster size == 1
3. ADC value == 22.5

The Noise hit and the delta-ray electrons can not be well separated.

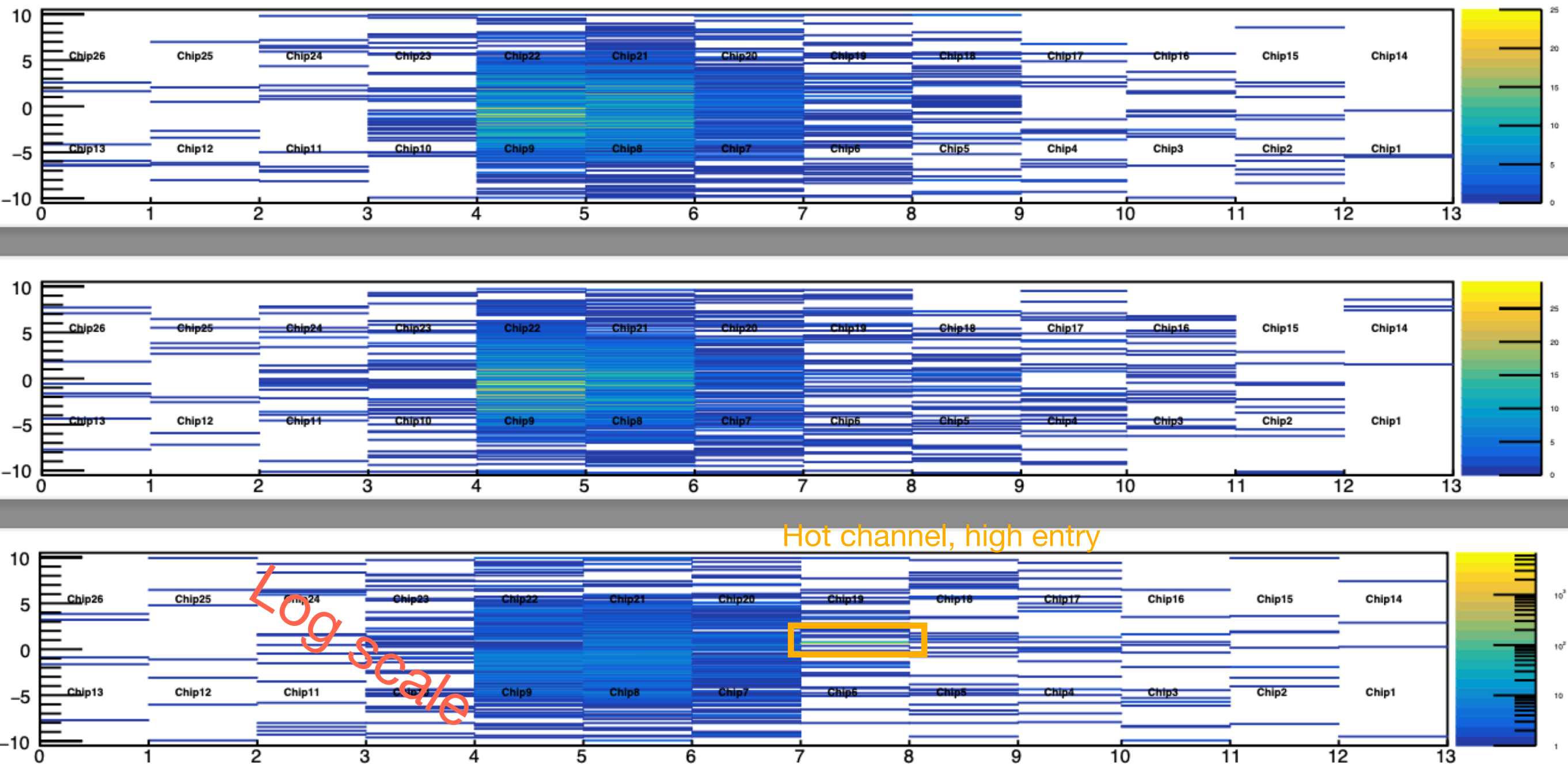


Run 52 - method 3, noise hit map

Criteria :

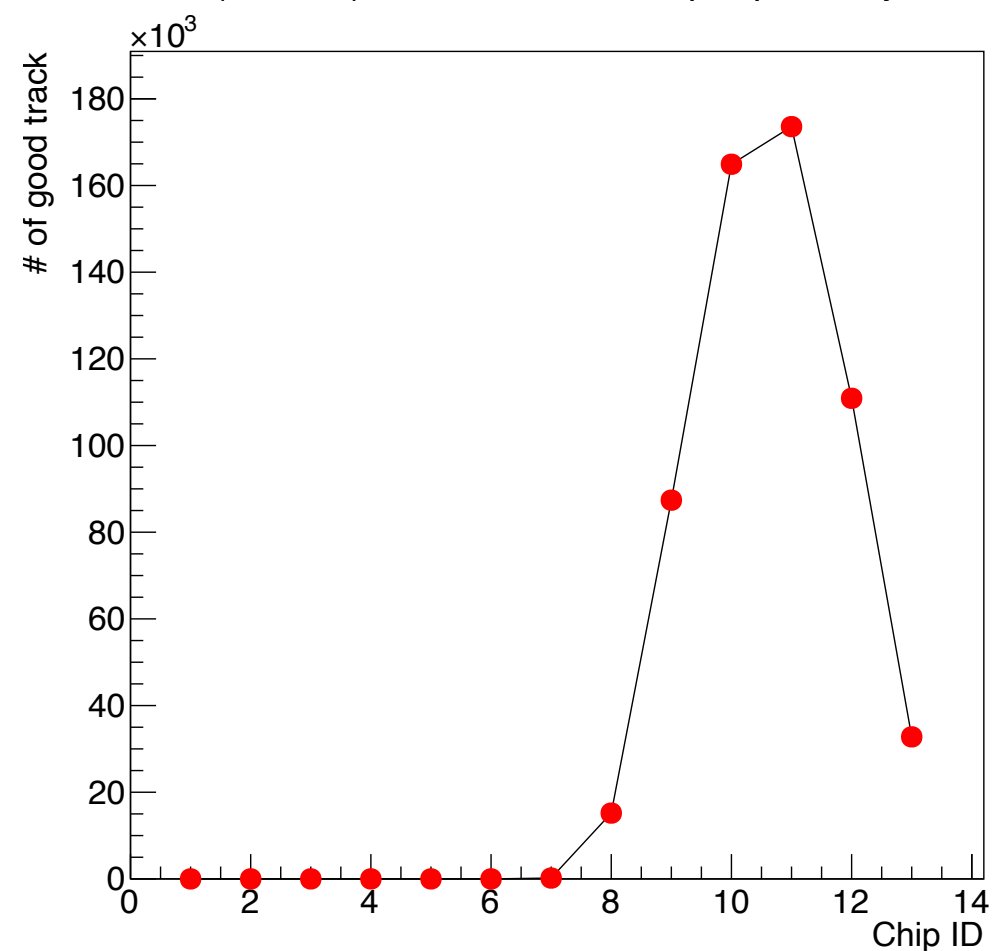
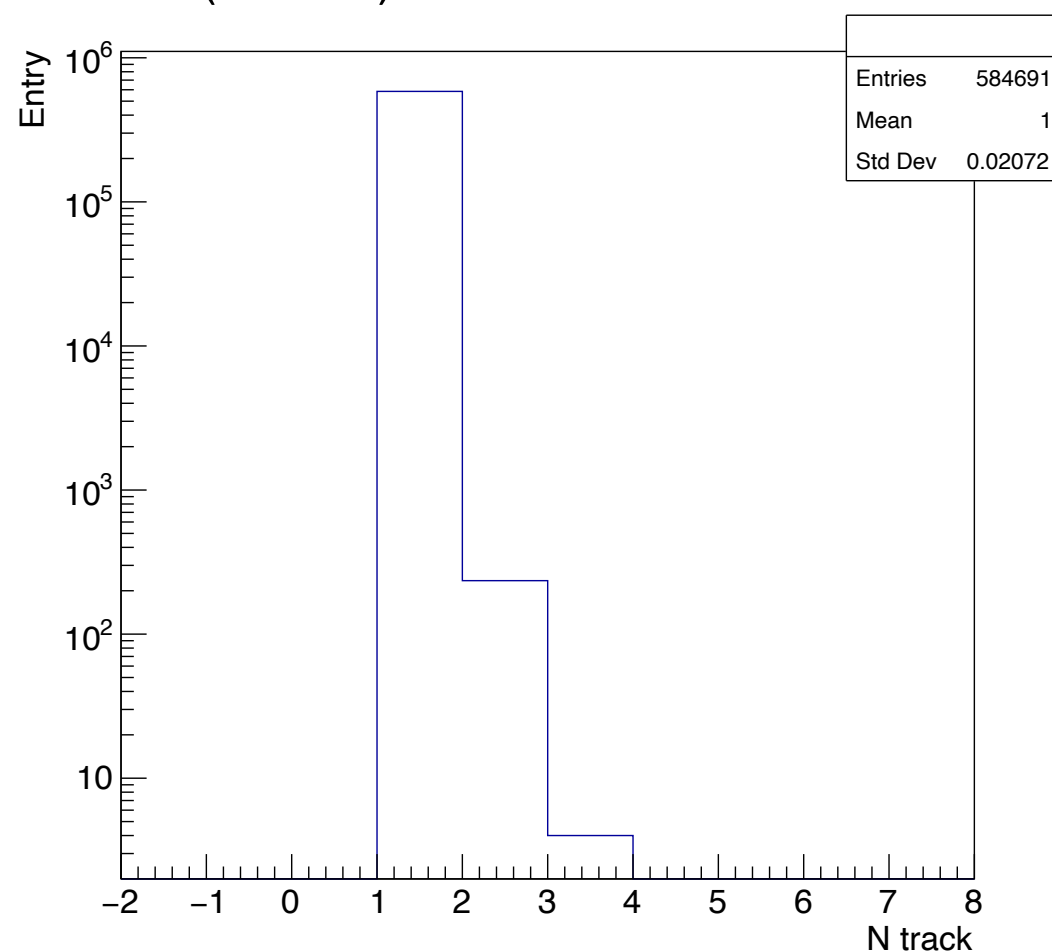
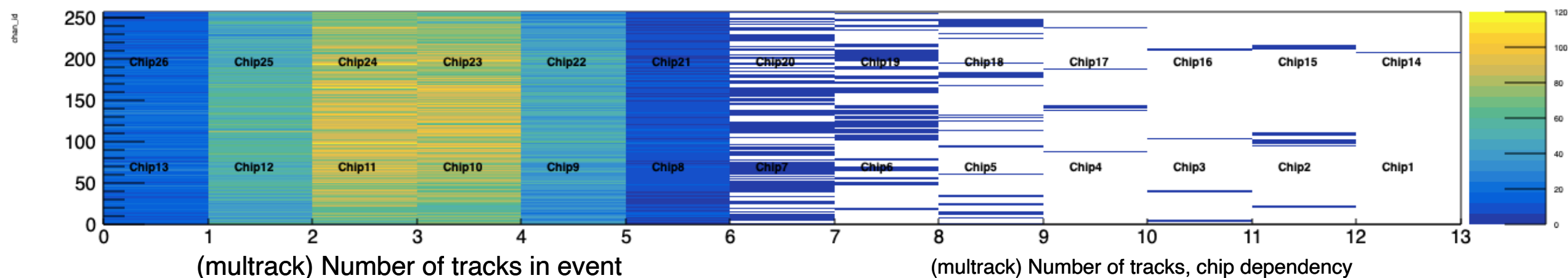
1. Have at least one good track
2. cluster size == 1
3. ADC value == 22.5

The Noise hit and the delta-ray electrons can not be well separated.



Run 52 MC, method 3

Pure MC, no fake noise hit

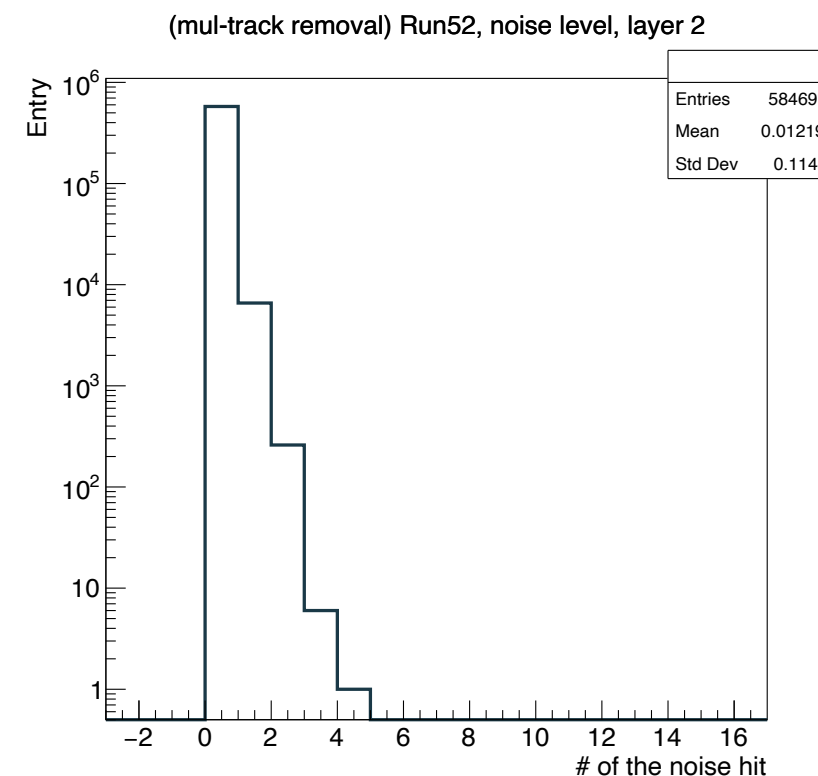
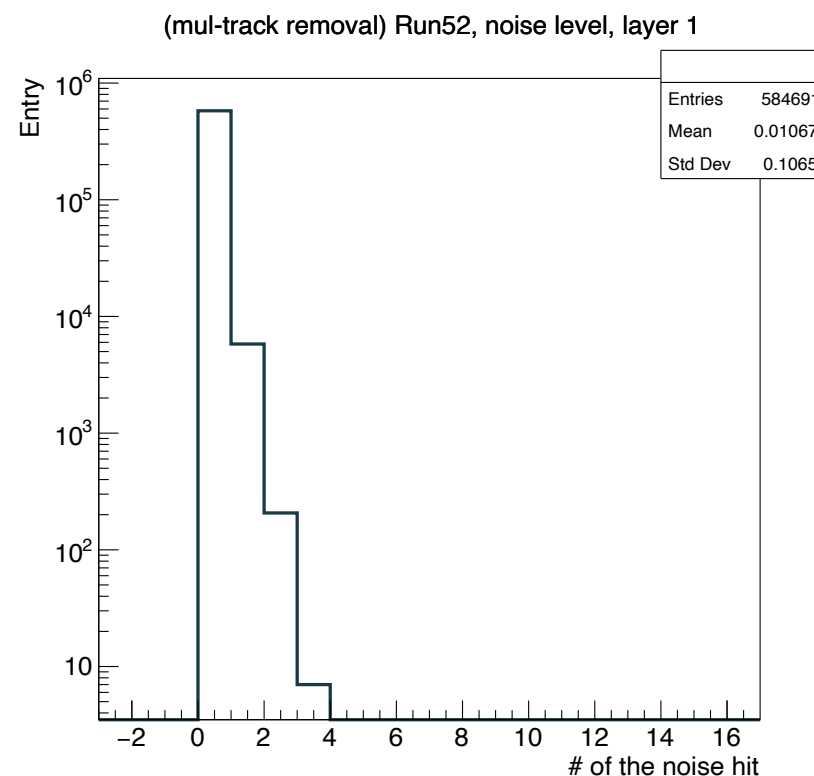
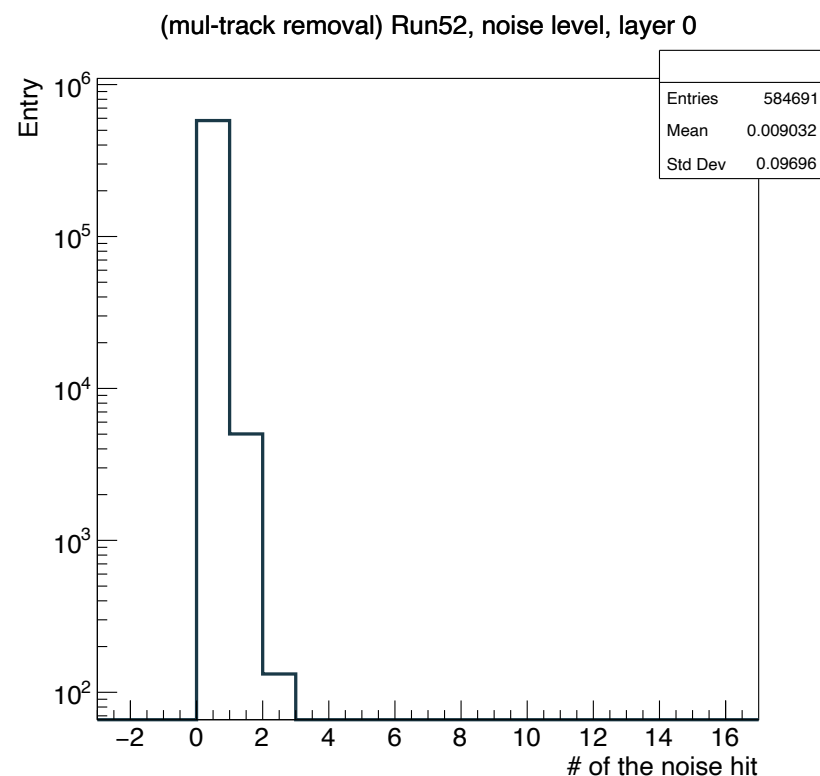
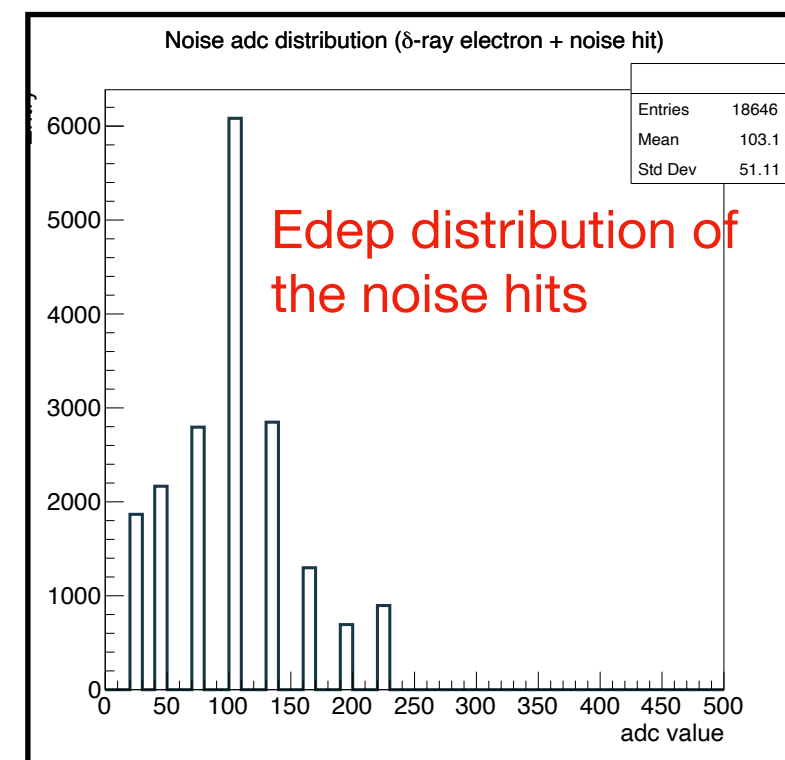
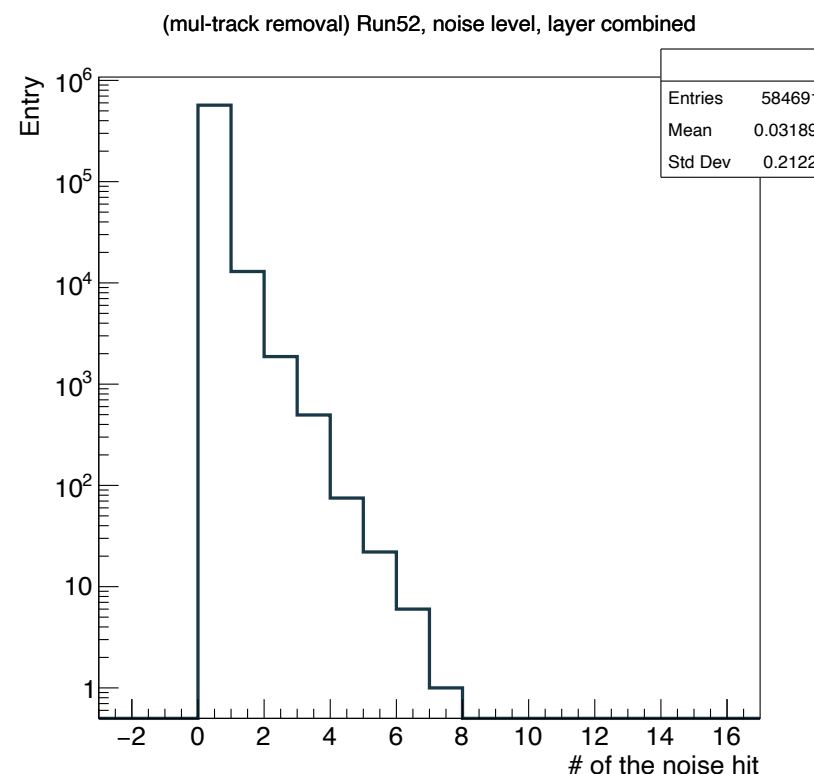


Run 52 MC, method 3

Criteria :

1. Have at least one good track
2. cluster size == 1

2.6% of the events have at least one additional hit (cluster size == 1) besides **at least one** good track.

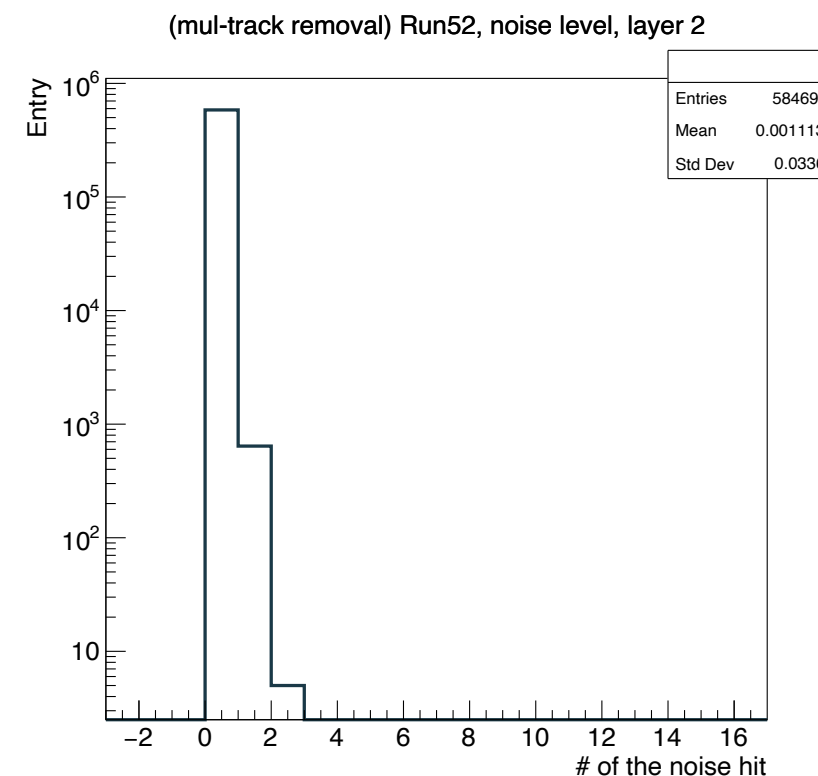
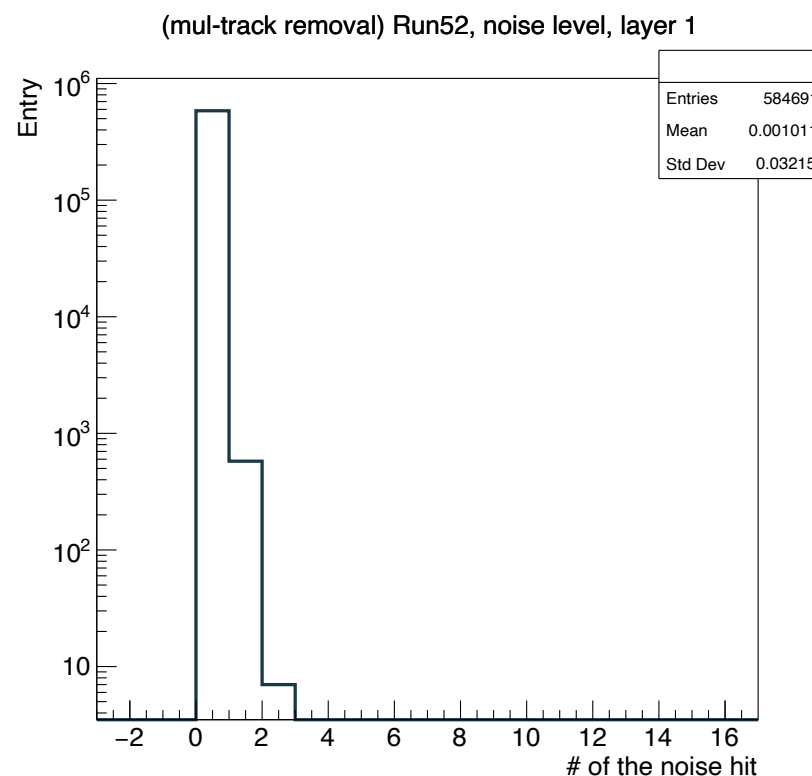
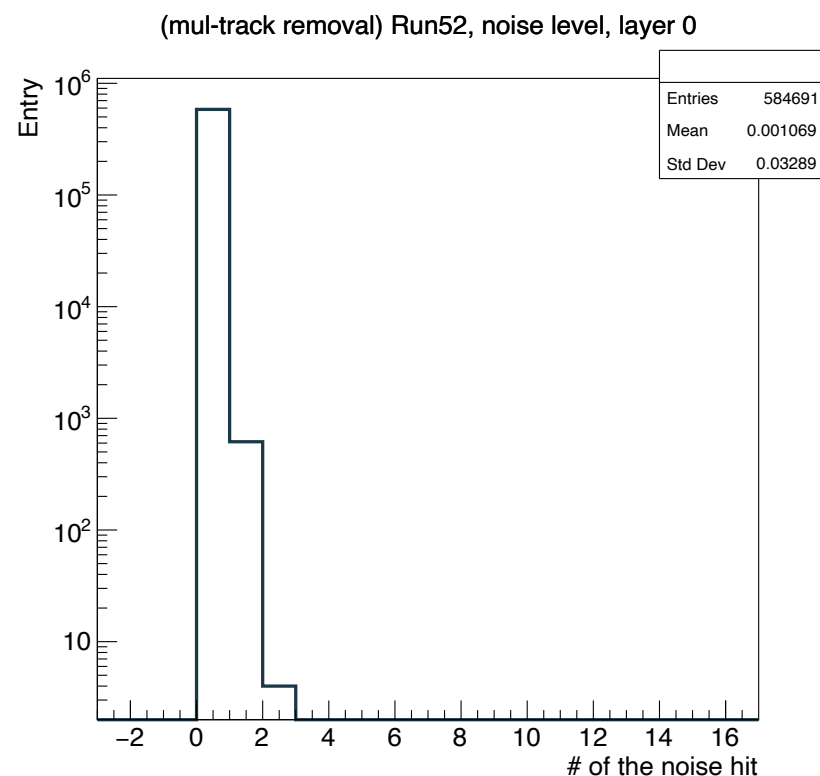
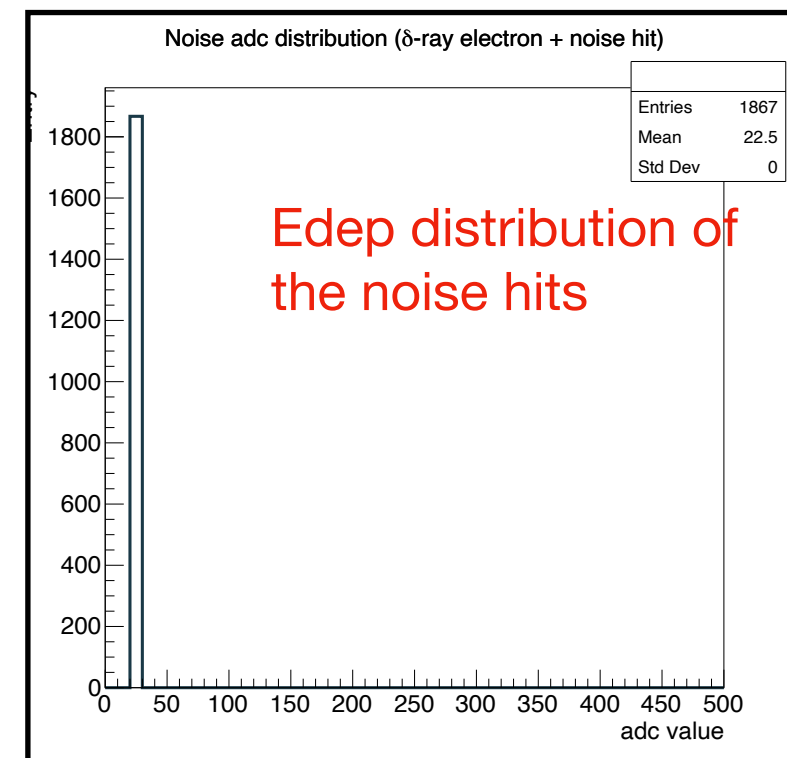
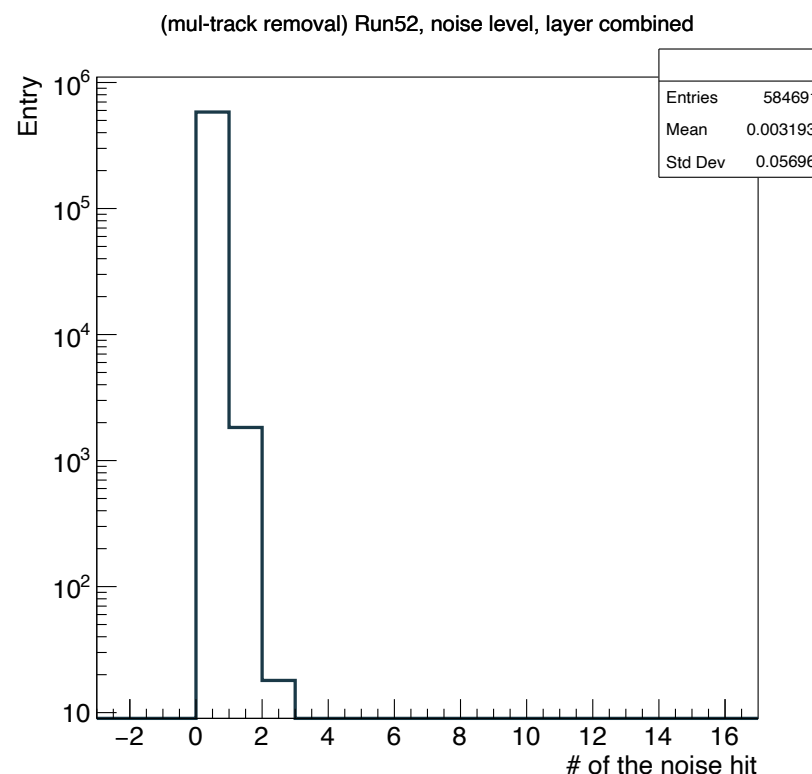


Run 52 MC, method 3

Criteria :

1. Have at least one good track
2. cluster size == 1
3. ADC value == 22.5

0.32% of the events have at least one additional hit (cluster size == 1) besides at least one good track.

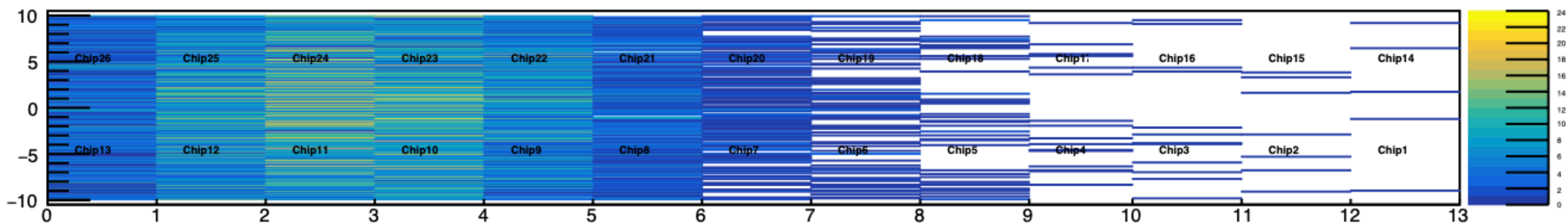
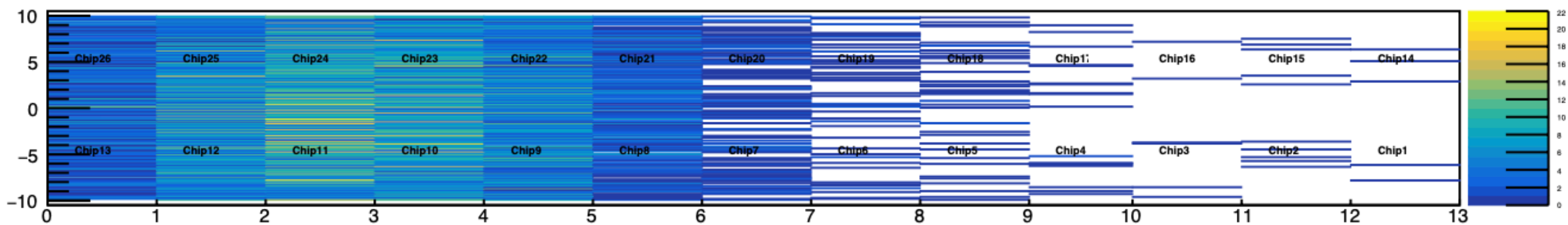
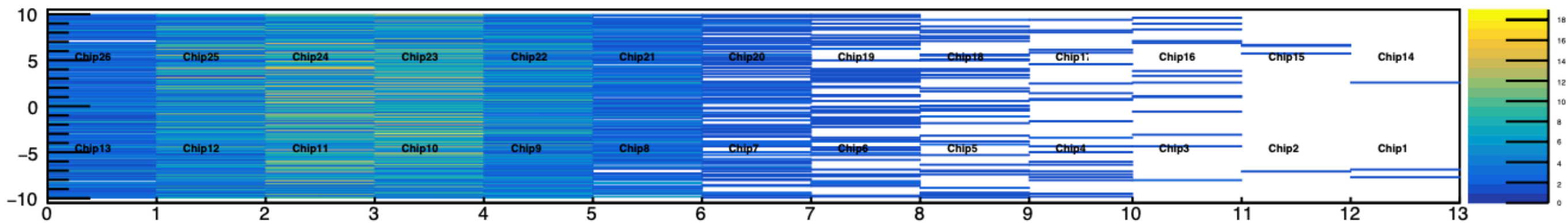


Run 52 MC, method 3, hit map

Criteria :

1. Have at least one good track
2. cluster size == 1

Pure MC, no fake noise hit

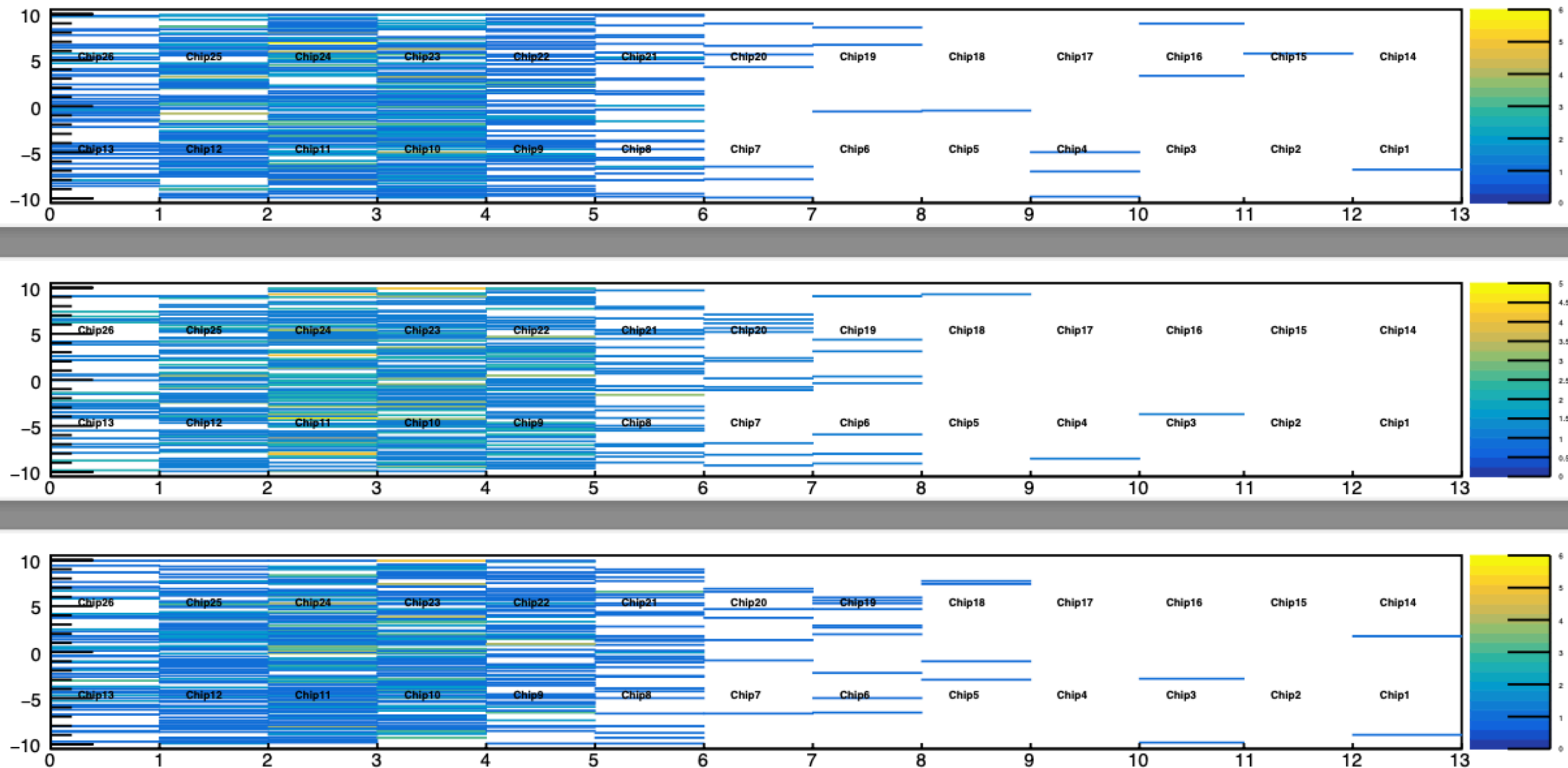


Run 52 MC, method 3, hit map

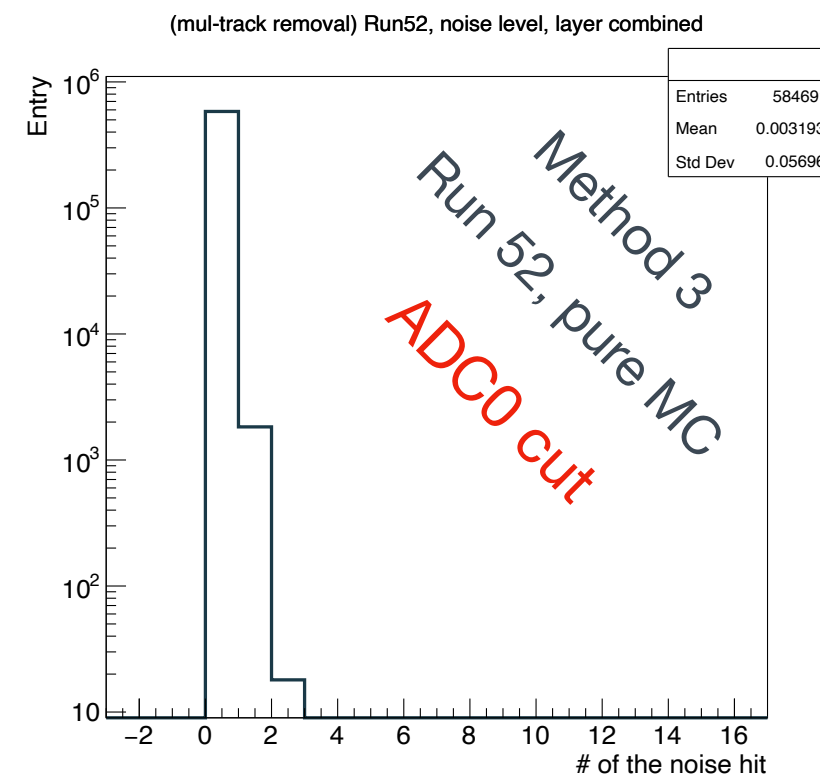
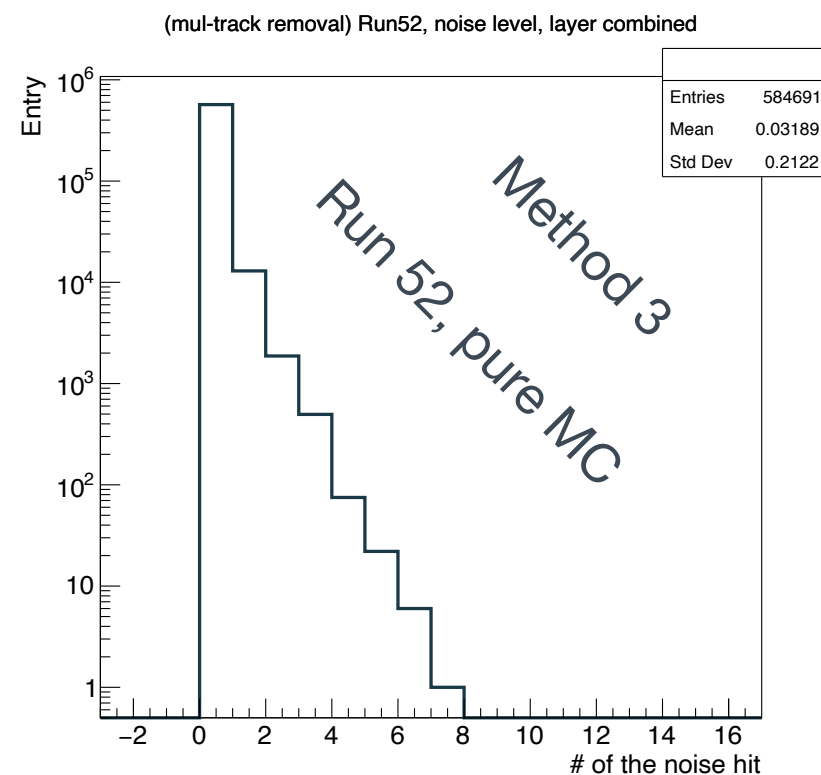
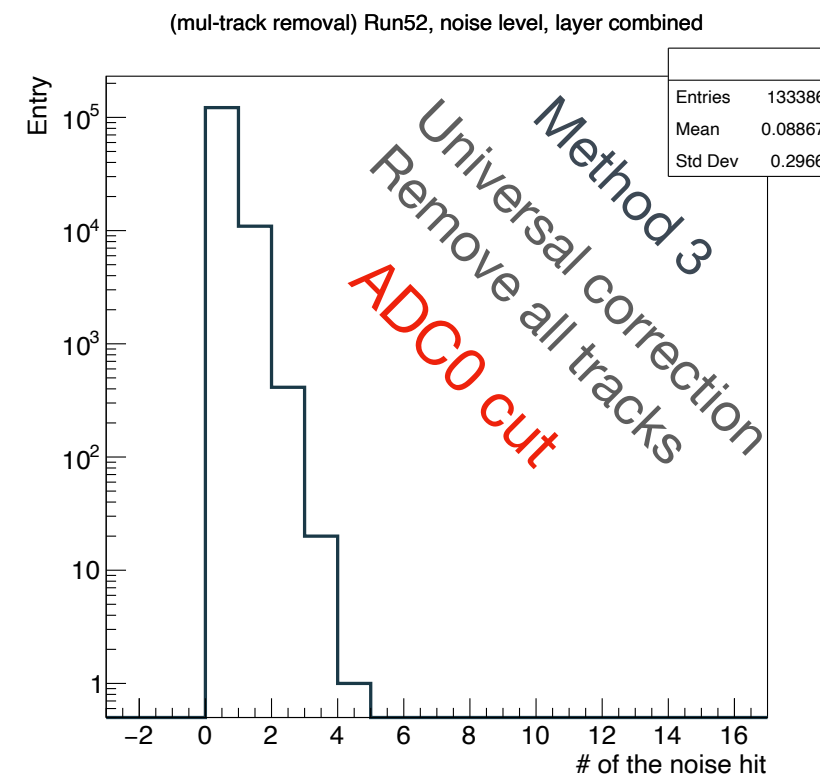
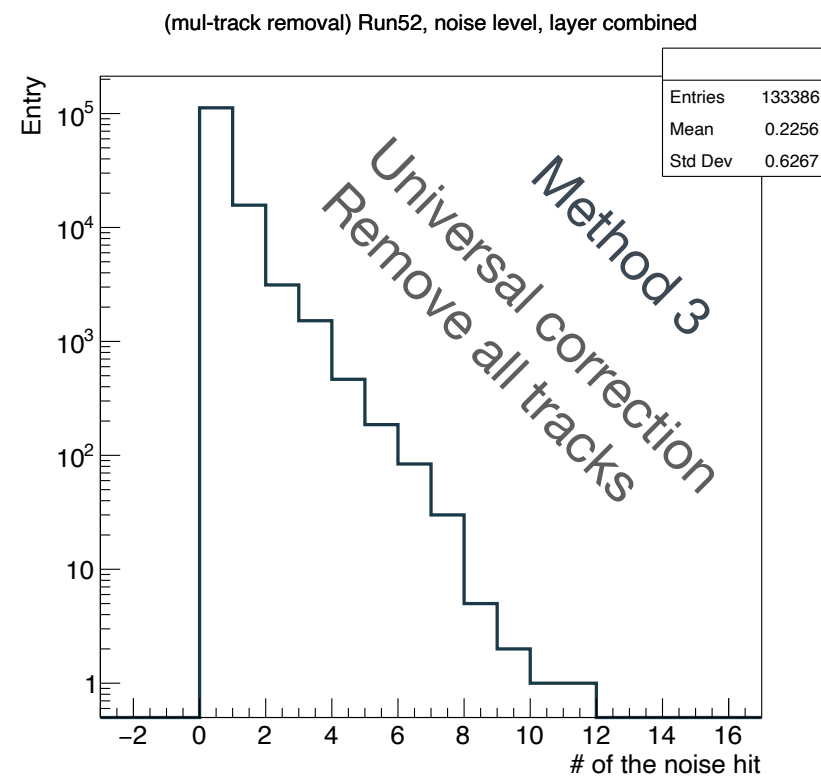
Criteria :

1. Have at least one good track
2. cluster size == 1
3. ADC value == 22.5

Pure MC, no fake noise hit

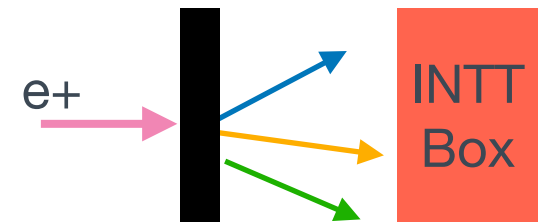


Comparison - run52 noise distribution



Comparison, # of track in each event

Universal alignment correction was applied
Same tolerance : 0.1374 mm



Run 52 MC

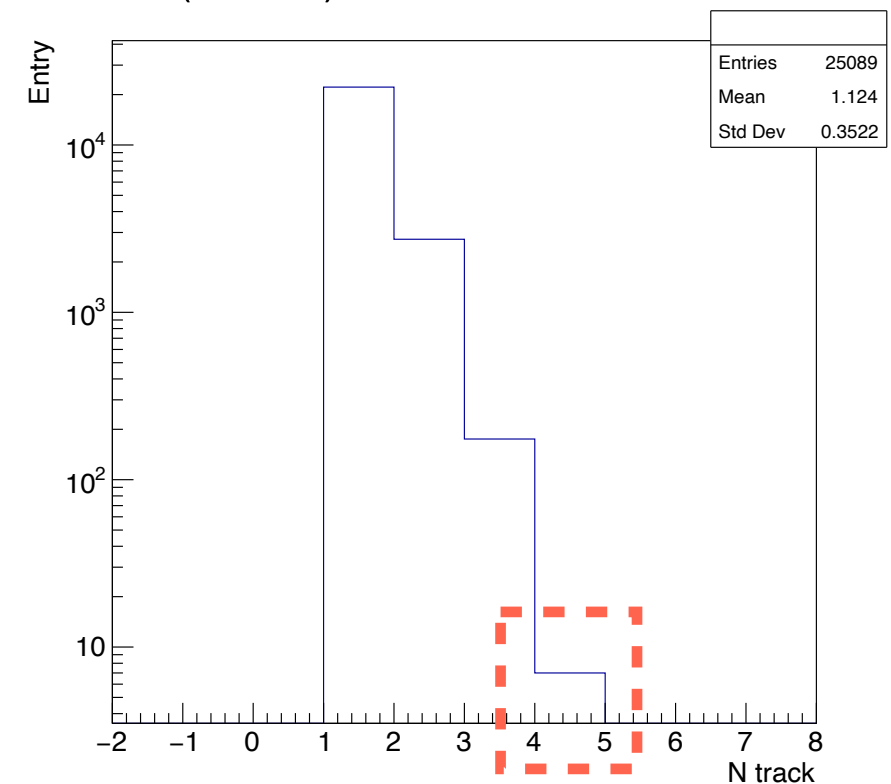
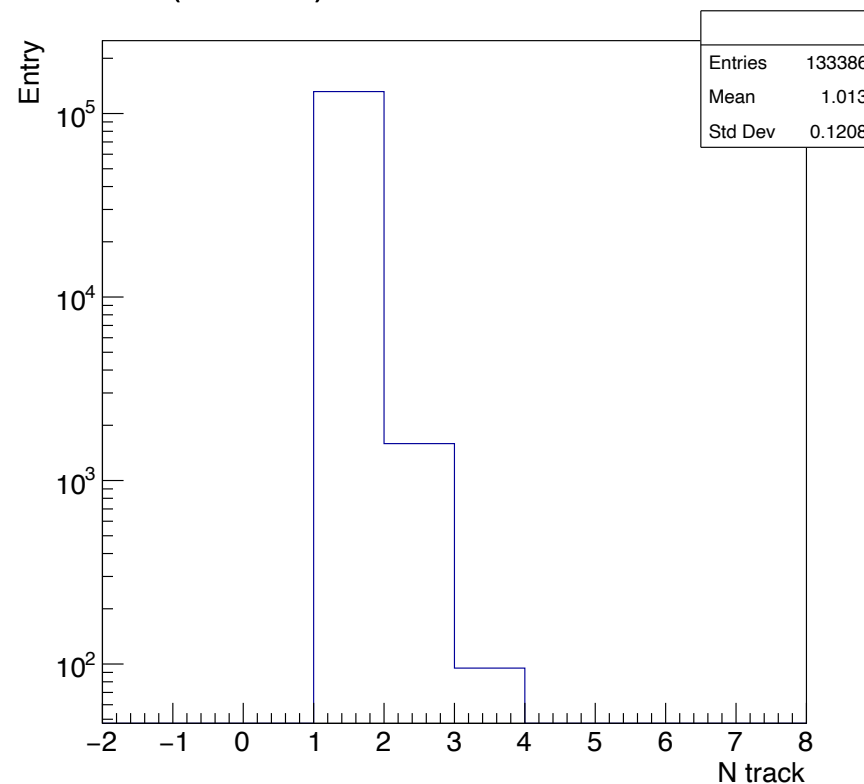
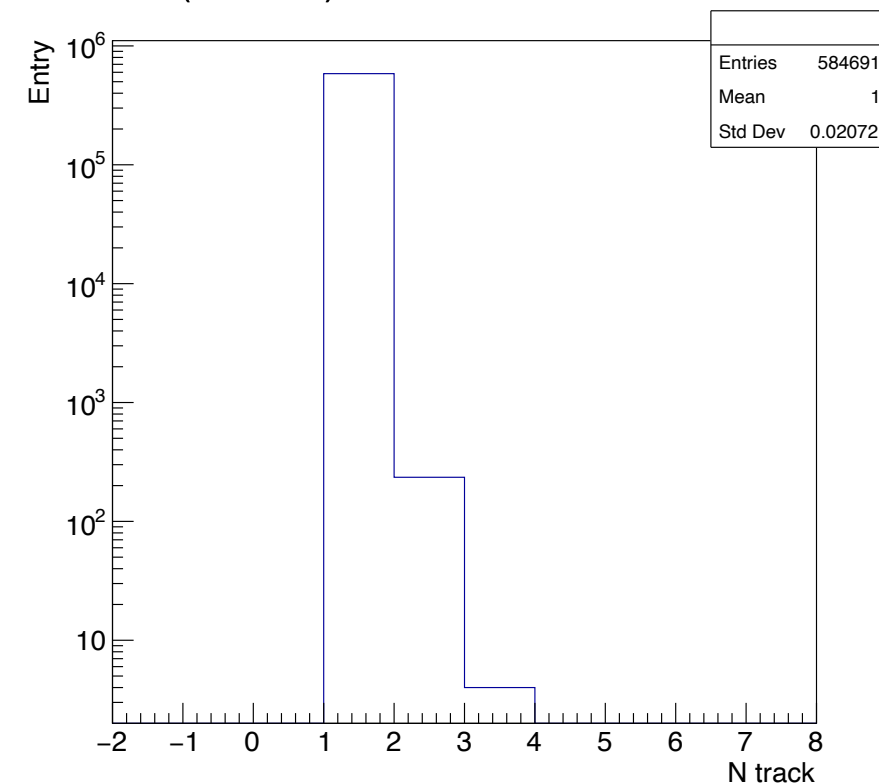
Run 52

Run 64, with lead plate

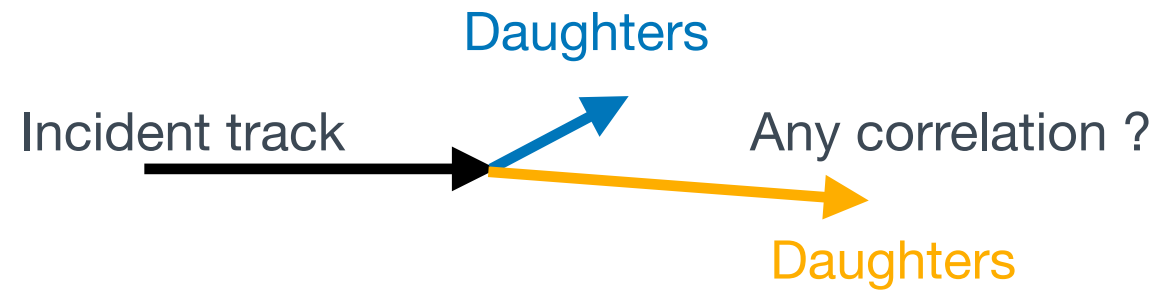
(multitrack) Number of tracks in event

(multitrack) Number of tracks in event

(multitrack) Number of tracks in event



The correlation of double tracks in single event

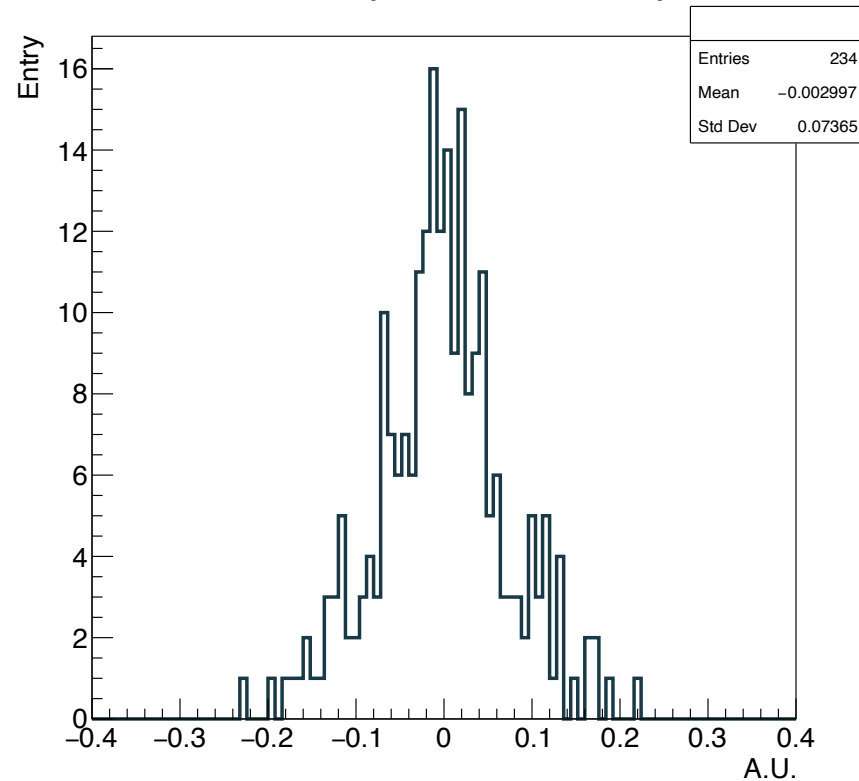


Run 52 MC

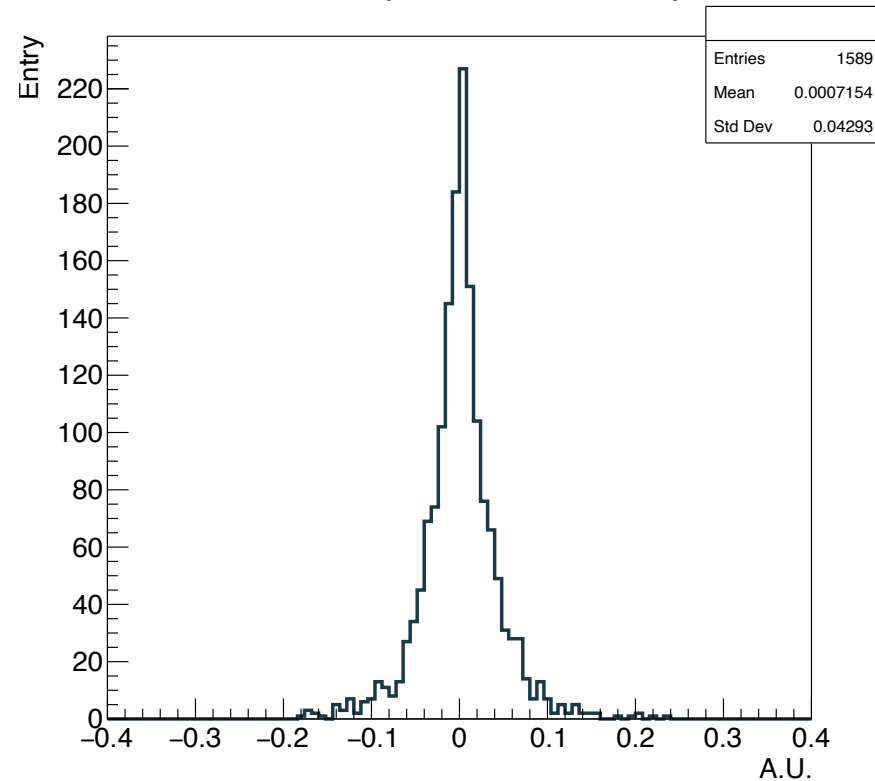
Run 52

Run 64, with lead plate

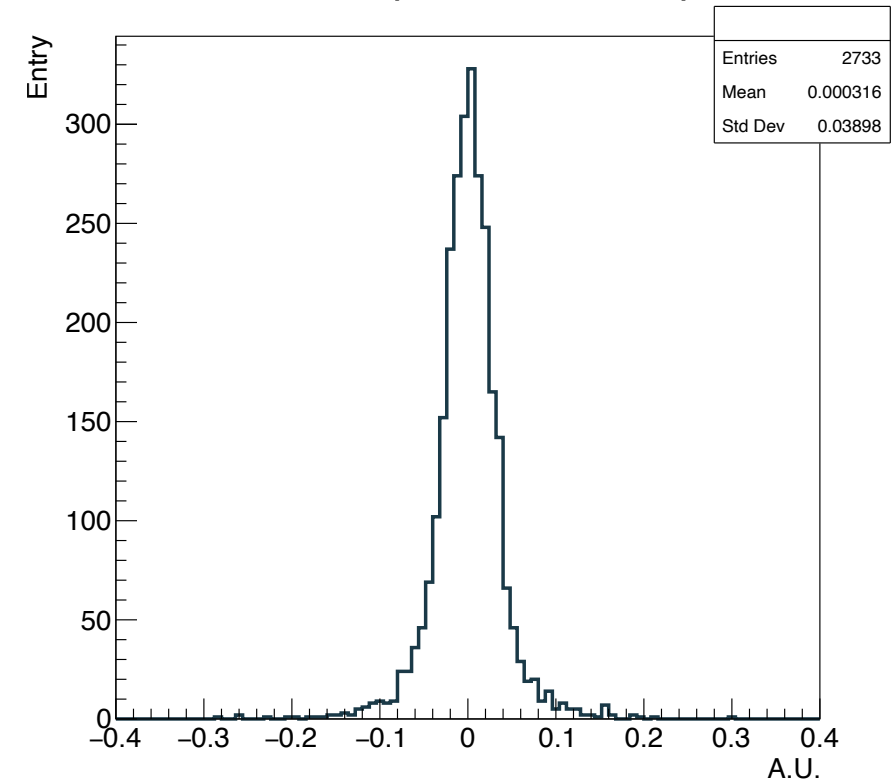
Track A slope - Track B slope



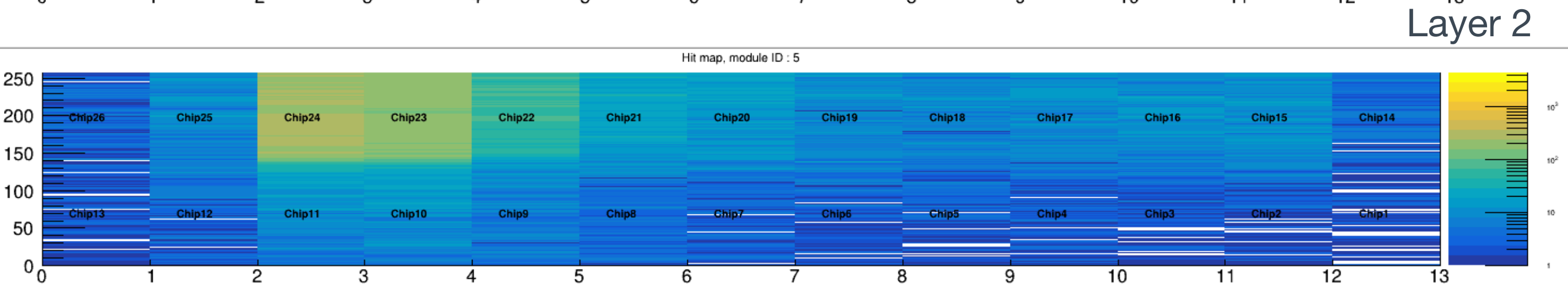
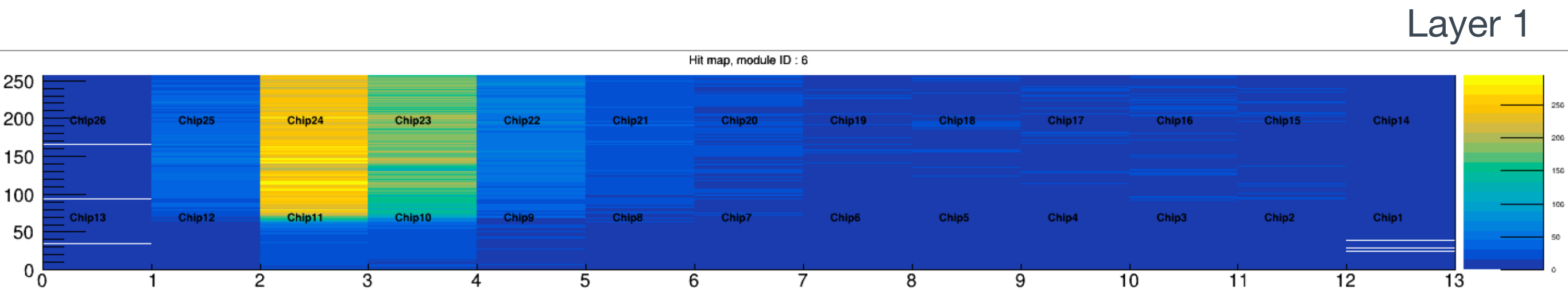
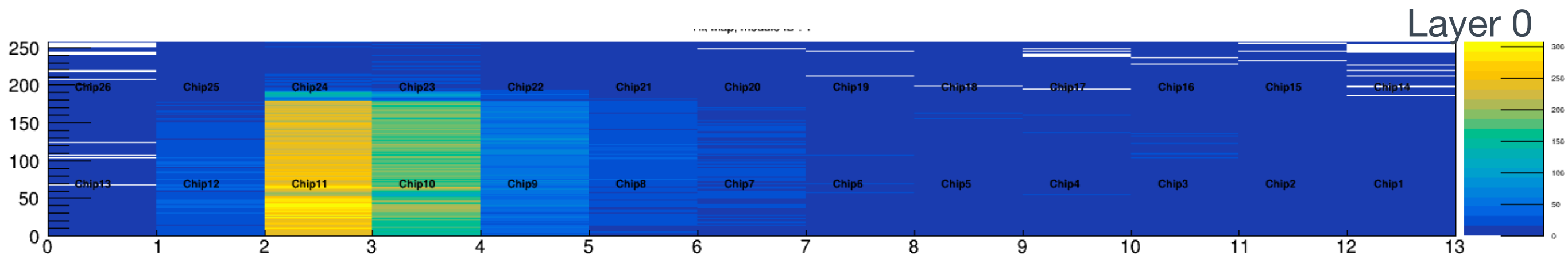
Track A slope - Track B slope



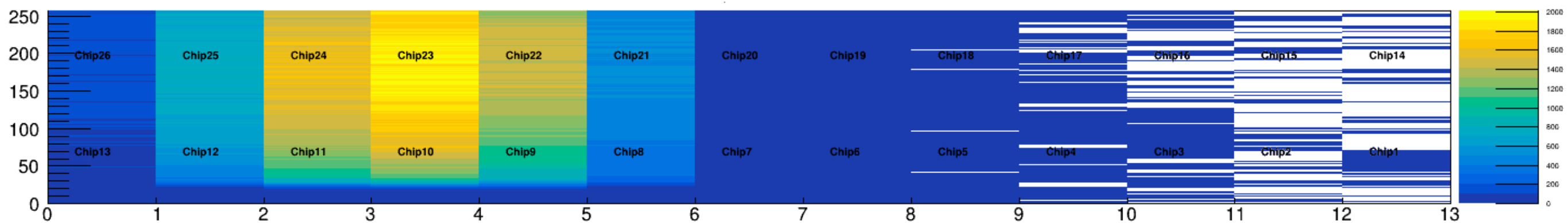
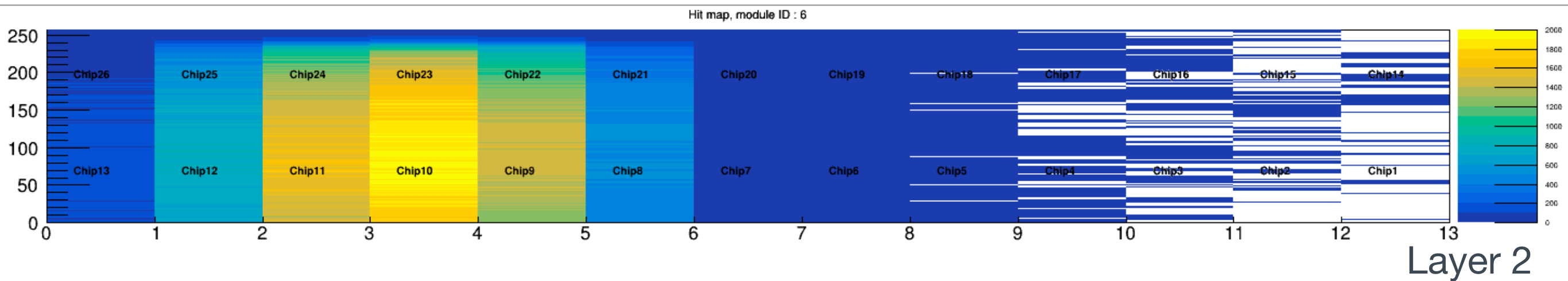
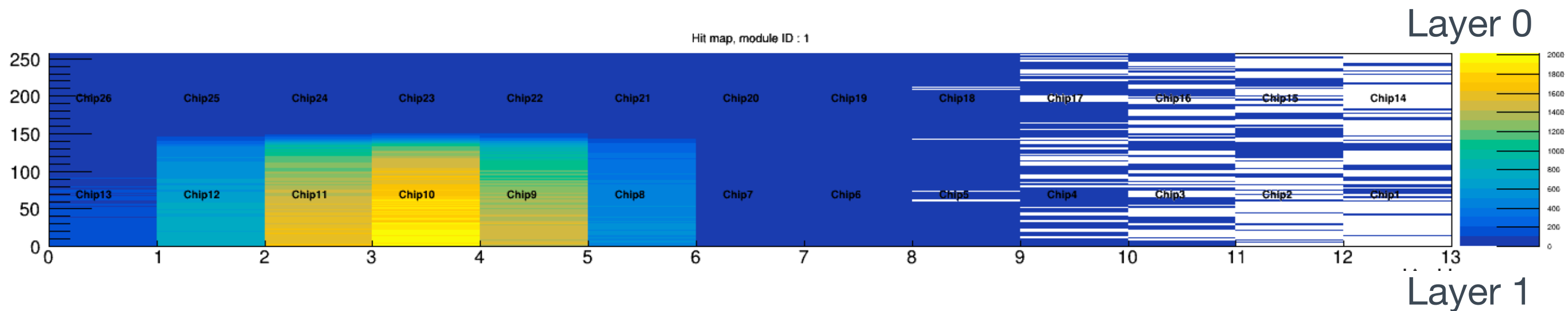
Track A slope - Track B slope



Run 61, hit map



Run 61 MC, hit map

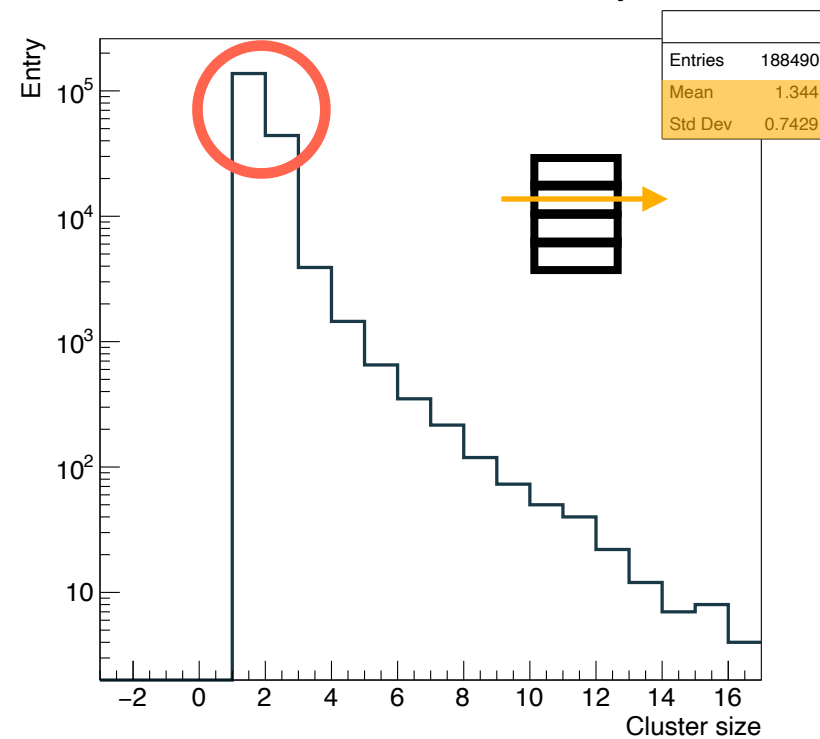


Comparison - cluster size distribution

All clusters

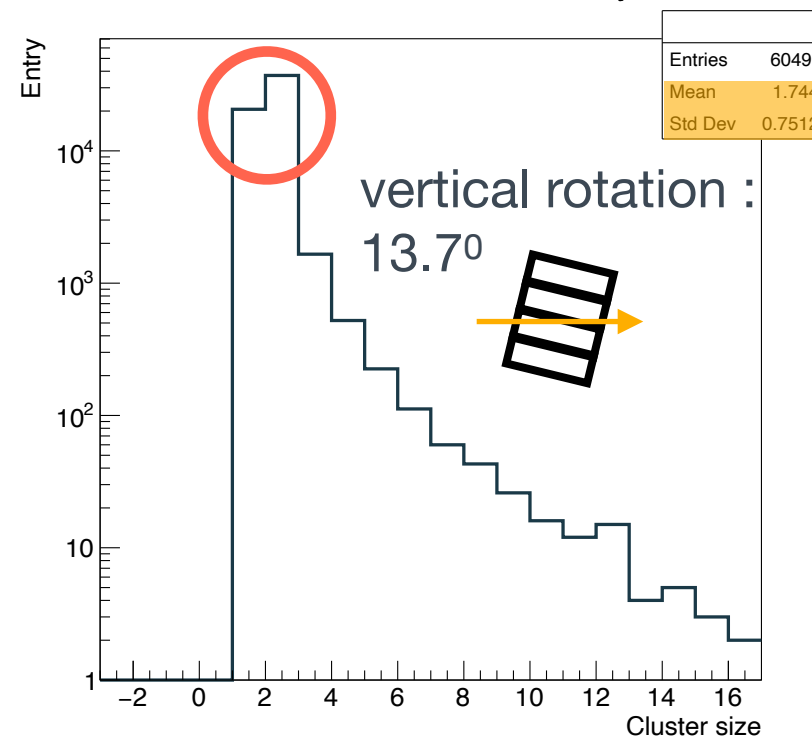
Run 52

Run52, cluster size, all clusters, layer : 0



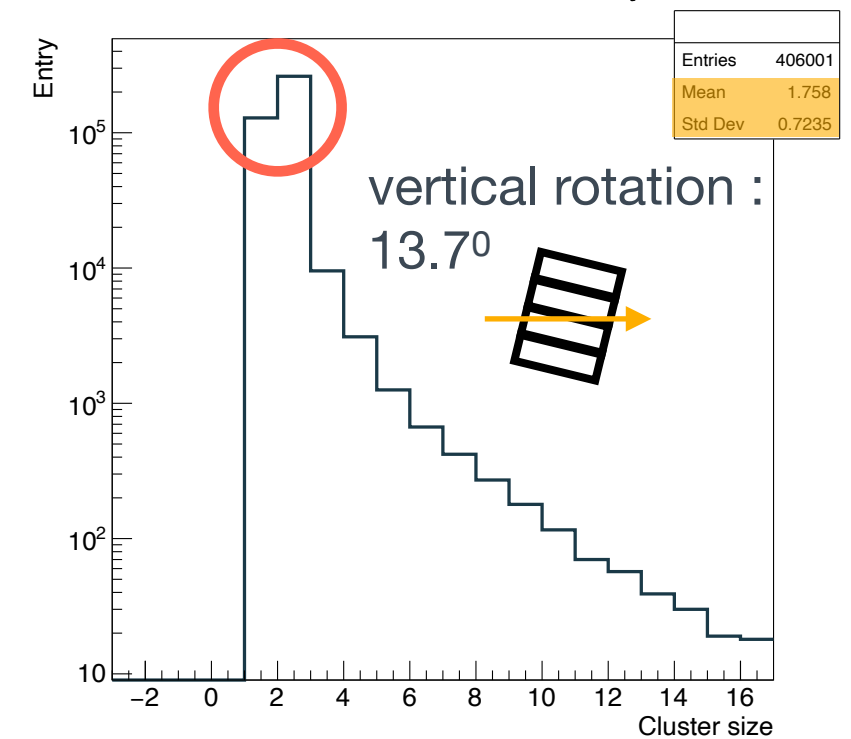
Run 61

Run61, cluster size, all clusters, layer : 0



Run 61 MC

Run61, cluster size, all clusters, layer : 0



Summary

- It's possible to have three good tracks in one event.
- The adc value cut is new considered. The suppression power is strong.
 - The distribution of the hit map is still not uniform.
 - Some clusters still pass all the criteria in the MC run.
- It's almost impossible to separate the noise hit and delta-ray electron well. (finding a droplet in rain)
- In the Run64 (with lead plate in front of INTT Box), the # of track distribution is more wider than the normal case.
- The track correlation study is performed. Most of the di-tracks seem to be from the same incident track.
- The vertical rotation configuration makes the cluster size distribution wider.

Back up

Run 61 condition

Run-061: Vertical rotation

Data file

BeamData_20211210-0928_0.dat

Beam

Momentum : 1000 MeV/c

Position: the dark box was moved to south by 3 cm, beam is on chip 10,11, 23, 24

Setup

H/V 測定

Vertical 13.7°

Trigger: scinti C only

veto, FEM へのコインシデンス入力はRun53 と同じ (coincidence input to veto and FEM are same as run53)

Measurement time

15min

HitMap

